

## Do Something. Be a Leader.

Rebecca Wilder, RDH, BS, MS

What does leadership mean to you?

I recently attended a meeting where the central theme was professional leadership. The very essence of the word can be scary to some. I have heard many professional dental hygienists say they do not have leadership qualities, they cannot stand up in front of a group of people and speak without almost passing out or they have too many things to deal with in their life to take on a leadership role. Maybe one day, they say, they will have time to be a leader and contribute to the profession. The reality is that, in most organizations, 20% of the members do most of the work and carry the load of the remaining 80%. What this means is that leadership in dental hygiene is carried out by 20% of the members. It seems to me that we have many untapped leaders out there.

At the same meeting on leadership, the presenter recited a poem that you may have heard before.

### **Everybody, Somebody, Anybody, and Nobody**

*This is a little story about four people named Everybody, Somebody, Anybody, and Nobody. There was an important job to be done and Everybody was sure that Somebody would do it. Anybody could have done it, but Nobody did it. Somebody got angry about that because it was Everybody's job. Everybody thought that Anybody could do it, but Nobody realized that Everybody wouldn't do it. It ended up that Everybody blamed Somebody*



*when Nobody did what Anybody could have done.*

- Author unknown

The poem made me think about our profession and how much we need leadership development. My philosophy is that everyone has some leadership potential. This does not mean that everyone will be a national leader, but it does mean that everybody/somebody/anybody can take on a role of importance and make a contribution. Personally, I did not start off being a leader - I was perfectly happy being a follower. Rarely is one born a leader. However, I was fortunate to have mentors who were good leaders and they showed me the way. I learned by observation. I started slow by volunteering under the direction of somebody else. The first time I stood before an audience of my peers to make a professional presentation I was petrified! But, I

learned and persevered and can now stand in front of a room full of people and talk about dental hygiene. You see, that is the thing about leadership. Through desire and perseverance, one can become a leader, but the skills need to be continuously honed and developed. One never really "arrives," which is what makes leadership development so dynamic and contagious.

What role could you take on as a leader in dental hygiene? It might mean being a leader in the local component of your dental hygiene association, or taking the lead with a community oral health event. What about teaching a group of caretakers the techniques for good oral hygiene that might touch the lives of patients in a nursing home? It may mean going into a school to talk about the importance of oral health or presenting a Power-Point presentation to a group of middle school students about the detrimental effects of tobacco use or use of drugs. Or perhaps you have a passion for the legislative process and want to get involved politically. You can take on a big role or an ever so small role - it doesn't matter. What matters is that you take on a role.

Our profession needs Everybody, Somebody, Anybody to be involved, support the profession of dental hygiene and make a difference. Do Something. Be a Leader!

Sincerely,  
Rebecca Wilder, RDH, BS, MS  
Editor-in-Chief, Journal of Dental Hygiene

## Health Literacy and Patient Communication

Karen Williams, RDH, PhD

The purpose of Linking Research to Clinical Practice is to present evidence-based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.

**Miller E, Lee J, DeWalt DA, Vann WF. Impact of caregiver literacy on children's oral health outcomes. *Pediatrics*. 2010;126(1):107-114.**

**Objective:** The objective of this study was to examine the relationship of primary caregivers' literacy with children's oral health outcomes.

**Methods:** We performed a cross-sectional study of children who were aged  $\leq 6$  years and presented for an initial dental appointment in the teaching clinics at the University of North Carolina at Chapel Hill School of Dentistry. Caregiver literacy was measured using the Rapid Estimate of Adult Literacy in Dentistry (REALD-30). The outcome measures included oral health knowledge, oral health behaviors, primary caregiver's reports of their child's oral health status and the clinical oral health status of the child as determined by a clinical examination completed by trained, calibrated examiners.

**Results:** Among the 106 caregiver-child dyads enrolled, 59% of the children were male, 52% were white and 86% of caregivers were the biological mothers. The bivariate results showed no significant relationships between literacy and oral health knowledge ( $p=.16$ ) and behaviors ( $p=.24$ ). However, there was an association between literacy and oral health status ( $p<0.05$ ). The

multivariate analysis controlled for race and income. This analysis revealed a significant relationship between caregiver literacy scores and clinical oral health status as determined by using a standardized clinical examination. Caregivers of children with mild to moderate treatment needs were more likely to have higher REALD-30 scores than those with severe treatment needs (odds ratio: 1.14, 95% confidence interval - 1.05-1.25,  $p=0.003$ ).

**Conclusions:** Caregiver literacy is significantly associated with children's dental disease status

### Commentary

**Commentary:** Health literacy has been identified as an important factor in general health outcomes. Recently, numerous studies suggested that poor health literacy results in greater health disparities, especially in vulnerable populations. In a recent column (*J Dent Hyg*. 2010;84(1):6-9.), I discussed the importance of engaging patients in meaningful interaction where the patient has the opportunity to explore their values and beliefs about oral and dental health, examine pros and cons related to changing oral health behaviors and articulate and resolve ambivalence to change in a non-judgmental environment. The reviewed studies on motivational interviewing provided evidence that strategies aimed at eliciting the patient's own motivation towards behavior change allows them to become invested in the change process, which can result in better health outcomes. Concomitantly, it is important to understand that many patients come to us with low health literacy, which may impact their ability to "obtain, process, understand and act on (health) information and services needed to make appropriate (health) decisions" (Healthy People 2010).

Historically, dental hygienists were taught to provide patient education through brushing/flossing demonstration, often accompanied by written educational materials sent home with the patient. Even today, this is a common strategy. This, coupled with a large volume of written patient educational materials available (a search on Google yielded more than 8 million hits), makes it easy for clinicians to distribute materials, often without having a full understanding of the patient's level of health literacy. Results published by the 2003 National Assessment of Adult Literacy (sponsored by the National Center for Education Statistics) suggest that 43% of adults in the U.S. are unable to use print materials for daily activities, including health activities. Moreover, other researchers were able to demonstrate that 28% of parents had very low health literacy, with more than 66% unable to correctly provide demographic data on health insurance forms. This low level of health literacy in the U.S. translates to more than 77 million individuals struggling with health care. In the area of general health, research has shown that poor health literacy results in less use of preventive services, more hospitalizations, greater costs and poorer outcomes. Given that dental caries is still the most common disease in children, these researchers hypothesized that caregivers poor health literacy may be a contributing factor to children's poor oral health.

This study used a cross-sectional approach to determine if there was a relationship between primary caregiver's literacy and the child's oral health. One hundred and six caregiver/children dyads attending the University of North Carolina School of Dentistry teaching clinic comprised a convenience sample in this

study. Children who presented for either an initial emergency or new patient exam were recruited for the study. In order to qualify for participation, children had to be  $\leq 6$  years of age and accompanied by their primary caregiver. Informed consent was obtained from the caregiver. If caregivers had difficulty reading the consent or HIPAA form, an interviewer assisted them by reading these documents aloud. Caregivers' literacy was then assessed using the Rapid Estimate of Adult Literacy in Dentistry (REALD-30). This instrument, comprised of 30 words related to dentistry, assesses reading ability within a dental health context. Caregivers were asked to read the words aloud and told to skip any word that they did not recognize. They were scored one point for each word read and pronounced correctly. Additionally demographic information, oral health knowledge, perceptions or oral health status and potential barriers were assessed using a verbally administered questionnaire. Following the assessment of the caregiver, the child's dental status was assessed using a 3-point caries severity index. Caregiver assessment was accomplished by 2 trained interviewers using a standardized sequence aimed at minimizing embarrassment. Children's examinations were performed by 2 calibrated clinical examiners.

Approximately 60% of the children were males, with race distributed as follows: white (53%), Black/African American (23%), Latina (10%) and other (14%). Approximately 86% of caregivers were mothers and only 33% had college degrees. Overall, the distribution of household income was fairly low, with 46% reporting yearly incomes  $\leq \$30,000$ . Caregivers overall level of oral health knowledge was fairly good (mean of 7.5 out of a possible 11 points). However, 43% reported they had fed their child by bottle at night. Of interest, approximately 57% perceived their child's dental health to be excellent, whereas 44% of children were caries free.

Results showed that REALD-30

score was not related to overall dental knowledge. However, the knowledge item about sugar exposure and caries risk was significantly related to the health literacy measure. Logistic modeling was used to examine whether the REALD-30 was significantly associated with disease severity (none/mild/moderate versus severe) while controlling for child's race and household income. The odds of children having the less caries severity were 1.14 times greater if caregivers had higher literacy scores. A relationship was not found between caregivers health literacy and perceived dental status of child.

This study is one of the first empirical investigations exploring the relationship between caregiver's health literacy and child's caries status. As such, the results have important implications for dental hygiene clinicians. Clear and appropriate communication techniques are needed if hygienists hope to have an impact on improving children's oral health. If the caregiver's literacy is taken into account during patient/parent engagement and communication, the clinician will undoubtedly be more effective. Additionally, understanding that poor caregiver literacy can predispose children to higher caries risk is important to keep in mind during professional interventions with pediatric patients.

**Parker EJ, Jamieson LM. Associations between Indigenous Australian oral health literacy and self-reported oral health outcomes. *Bmc Oral Health*. 2010;10(3):3.**

**Objective:** To determine oral health literacy (REALD-30), oral health literacy-related outcome associations and to calculate if oral health literacy-related outcomes are risk indicators for poor self-reported oral health among rural-dwelling Indigenous Australians.

**Methods:** 468 participants (aged 17-72 years, 63% female) completed a self-report questionnaire. REALD-30 and oral health literacy-related outcome associations were determined through bivariate analy-

sis. Multivariate modeling was used to calculate risk indicators for poor self-reported oral health.

**Results:** REALD-30 scores were lower among those who believed teeth should be infrequently brushed, believed cordial was good for teeth, did not own a toothbrush or owned a toothbrush but brushed irregularly. Tooth removal risk indicators included being older, problem-based dental attendance and believing cordial was good for teeth. Poor self-rated oral health risk indicators included being older, health care card ownership, difficulty paying dental bills, problem-based dental attendance, believing teeth should be brushed infrequently and irregular brushing. Perceived need for dental care risk indicators included being female and problem-based dental attendance. Perceived gum disease risk indicators included being older and irregular brushing. Feeling uncomfortable about orofacial appearance risk indicators included problem-based dental attendance and irregular brushing. Food avoidance risk indicators were being female, difficulty paying dental bills, problem-based dental attendance and irregular brushing. Poor oral health-related quality of life risk indicators included difficulty paying dental bills and problem-based dental attendance.

**Conclusions:** REALD-30 was significantly associated with oral health literacy-related outcomes. Oral health literacy-related outcomes were risk indicators for each of the poor self-reported oral health domains among this marginalized population.

## Commentary

As with many poor and disadvantaged populations in the U.S., Indigenous Australians have greater unmet health needs than non-Indigenous Australians. Moreover, they suffer a greater burden of oral diseases with more severe periodontal disease, fewer filled teeth, more missing teeth and less access to preventive care than their non-Indigenous counterparts. These authors

took a slightly more sophisticated approach to exploring the relationship between health literacy and oral health measures by including other explanatory factors in their predictive model, including: age and sex, socio-economic factors, use of dental services, oral health knowledge, oral health literacy and current oral health behaviors. Like the previous study, they used the REALD-30 to assess oral health literacy. However, oral/dental status was obtained via self report of 7 domains: having had one or more teeth extracted, self-rated oral health, perceived need for care, discomfort about appearance, food avoidance because of tooth/mouth problems and oral health-related quality of life.

Four-hundred and sixty-eight Indigenous Australians living in the Port Augusta region of South Australia participated in the study. The study was approved by the Aboriginal Health Council of South Australia as well as the University of Adelaide Research Ethics Committee. All subjects provided informed consent, and for those with limited reading ability, the consent form was read to them during the consent process. The average age of participants was 38, with 63% female.

Seventy percent reported that they had lost at least 1 tooth, 56% reported needing fillings or extractions, 56% were uncomfortable about the appearance of their mouth and 55% avoided eating certain foods because of their oral condition. Feeling uncomfortable about one's appearance was higher for older participants with low health literacy scores and those who did not brush teeth the preceding day. Additionally, those with lower oral health related quality of life were more likely to have lower literacy scores and seek care only when experiencing dental problems.

REALD-30 scores were compared between individuals who do and do not brush daily, between those who own versus don't own a toothbrush and between those who believed that cordial was good

versus bad for the teeth. In these comparisons, not surprisingly, individuals with higher health literacy scores were more likely to engage in health promoting behaviors and beliefs. In the multivariate modeling, after controlling for other possible confounders, low health literacy was found to be a statistically significant independent risk factor for all 7 self-reported oral health domains.

The authors were quick to caution that the participants in this study were a convenience sample from a defined region in Australia, and the REALD-30 measures word recognition, not comprehension or functionality. Despite these possible shortcomings, the consistency of association across all 7 domains of self-reported oral health gives some confidence that these findings are not spurious. As a preliminary study of health literacy in this population, there is clearly a need to better understand the intricate nature of health literacy on adverse oral health outcomes in order for appropriate interventions to be formulated.

### The Bottom Line

Effective patient-engagement and communication to effect oral health-related behavior change is one of the most rewarding, and challenging roles for dental hygienists. In the past decade, increasing attention has been given to factors that influence optimal oral health outcomes, as well as those that increase adverse outcomes. As I concluded in my previous column on Motivational Interviewing, application of the findings from cognitive psychology to oral health education and preventive counseling increases the likelihood of successful behavior change on the part of our patients. Similarly, understanding the role that health literacy plays in adversely impacting oral health, especially in underserved populations, is critical to maximizing impact of educational efforts.

In 2003, the American Dental

Education Association approved the competencies for Entry into the Profession of Dental Hygiene. [J Dent Ed. 2008;72(7):827-831]. This document requires the graduating hygienist to possess general knowledge regarding health, health determinants and characteristics of various populations that influence oral health in individuals and populations. As evidence about health disparities increases, dental hygiene clinicians need to reconsider their practice standards and modes of patient-engagement and, as needed, re-tool in order to increase their effectiveness with individuals and populations. In the context of oral health, clinicians need to understand that functional health literacy includes the knowledge, skills and capacity for individuals to understand the causes of disease, to engage in self-promoting oral health behaviors, to be able to navigate dental delivery systems effectively and to make decisions that advance their oral health. This implies that dental hygiene interventions cannot be conceptualized and delivered to individuals in a standardized manner. Increasing collection of patient-level and population-level information to better assess literacy skills is just as important as using findings from cognitive psychology to engage patients effectively. The results from the above referenced studies provide preliminary evidence to support that health literacy varies widely within and between populations, appears to be predictive of oral health outcomes and is an important factor in managing patients and populations.

These studies suggest that oral health literacy may be a critical predictor of patient and population based outcomes. Clearly, the science on health behaviors, health literacy and engaging patients effectively is still fairly young. The growing body of evidence in dentistry and medicine suggests that achieving optimal oral health is only achievable by understanding the complex nature of human behavior. I antici-

pate over the next decade that dental and dental hygiene researchers will unravel and understand much of this complexity and identify elements for effective interventions. Until that time, the following conclusions appear to be supportable from the emerging literature:

- Oral health literacy, like general health literacy, is highly variable in human populations and appears to be related to oral health outcomes
- Dental hygienists need to be cognizant of their patient's health literacy as low literacy may present a barrier to oral health education
- Achieving optimal oral health requires clinicians who can use emerging scientific information on health outcomes

## Summary

Over the past 3 years, I have advocated for dental hygiene clinicians to use best practice standards of care by incorporating scientific evidence into their daily practice. Research over the past decade about the multi-factorial nature of oral diseases, biological/social/cultural determinants of health and disease and principles of human behavior and cognition as they relate to health behaviors has changed the landscape for dental hygiene practice. Concomitantly, scientific findings provide excellent guidance on how dental hygienists can raise the bar in their own practices. It has also clarified the level of unmet need and possible reasons for poor

oral and general health in America. The impact of poor health literacy on an individual's health seeking behaviors, adoption and maintenance of preventive care, ability to make good decisions about daily oral care and understanding of professional counsel needs to be at the forefront of every clinician/patient interaction.

Many free resources exist for clinicians to improve their understanding of health literacy. The National Patient Safety Foundation has developed the AskMe3 campaign (<http://www.npsf.org/askme3/>), which seeks to improve patient/clinician communication by providing simple strategies for health care providers and patients alike. Health Resources and Services Administration has a free on-line course aimed at improving patient/clinician communication by addressing issues of literacy and cultural competency (<http://www.hrsa.gov/publichealth/healthliteracy/>). This on-line course can be done at one's leisure and takes approximately 5 hours to complete. Lastly, organized dentistry recently adopted the ADA Health Literacy in Dentistry Action Plan for 2010-2015 ([http://ada.org/sections/professionalResources/pdfs/topics\\_access\\_health\\_literacy\\_dentistry.pdf](http://ada.org/sections/professionalResources/pdfs/topics_access_health_literacy_dentistry.pdf)). This document provides valuable information about the impact of poor health literacy in dentistry and outlines a multi-faceted action plan. It is available on-line as a PDF file and a must-read for all oral health professionals.

Dental hygiene education is be-

ginning to incorporate health literacy content into curricula. Evolution of curricula from an evidence-based perspective offers the most effective means for changing patient/clinician communication, however, experienced clinicians in the field have the responsibility to remain abreast of research findings and intentionally select continuing education venues that allow them to retool to improve patient outcomes. Clearly, dental hygienists are the key oral health professional to improve patient and population outcomes through preventive counseling and care. While having knowledge about the biology of oral health and disease at one's fingertips is necessary for counseling patients, it is not sufficient, especially for traditionally underserved populations and individuals with low health literacy. Clinicians must have superb communication skills that take into account interacting with individuals and populations with a wide range of health literacy. Effective patient education and counseling can only occur when patients understand and can act on advice. As evidence increases in this area, it undoubtedly will change the manner in which we engage our patients and effectively communicate.

*Karen B. Williams, RDH, PhD, is a Professor and Chair of Biomedical and Health Informatics at the University of Missouri-Kansas City School of Medicine.*

# Critical Issues in Dental Hygiene

## The Dental Hygiene Faculty Shortage: Causes, Solutions and Recruitment Tactics

Elizabeth Carr, RDH, BS; Rachel Ennis, RDH, BA; Laura Baus, RDH, BS

### Introduction

Perceived causes and suggested solutions for the dental hygiene faculty shortage play a role in America's access to care problem. The ability of an individual to obtain dental care is known as access to care.<sup>1</sup> The lack of access to dental care gained national prominence in May of 2000 when the U.S. Department of Health and Human Services published the United States Surgeon General's National Call to Action to Promote Oral Health.<sup>2</sup> The American Dental Education Association (ADEA) believes dental educators should promote and ensure access to effective oral health care,<sup>3</sup> and as debates regarding solutions are ongoing, the general consensus is that reversing the trend of faculty shortages would create more dental care providers, and thus alleviate the access to care problem.<sup>1-3</sup> This literature review focuses on the dental hygiene faculty shortage. Current peer-reviewed publications were examined for pertinent information associated with faculty shortages in the dental professions.

### Review of the Literature

Faculty shortages affect both students and patients.<sup>4</sup> Some of the reasons faculty positions remain open are too few applicants, more faculty members leaving academia than entering and faculty members moving into private practice.<sup>5,6</sup> Information assessing dental hygiene educators reveals almost half of full-time fac-

### Abstract

**Purpose:** Peer-reviewed professional publications were examined for pertinent information associated with faculty shortages in the dental professions. The review found 6 suggested causes, including inadequate compensation, lack of diversity amongst faculty, inadequate mentoring for new faculty, lack of modeling to prospective dental hygiene educators, little awareness of faculty shortages and lack of institutional support for dental hygiene faculty. The causes and solutions for faculty shortages and recruitment tactics employed by parallel professions were evaluated to determine their applicability to the dental hygiene faculty shortage. There remains a scarcity of information regarding dental hygiene faculty shortages and how dental hygiene programs and institutions should address such shortages.

**Keywords:** dental hygiene, faculty shortage, education, mentoring, diversity, compensation

This study supports the NDHRA priority area, Professional Education and Development: Evaluate the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public.

ulty members are approaching retirement age, which is expected to create vacancies within the next 10 years.<sup>5-8</sup>

Shortages may stem from dental hygienists lacking the education needed to become effective educators.<sup>8,9</sup> According to the Commission on Dental Accreditation, dental hygiene educators should possess a minimum of a baccalaureate degree.<sup>10</sup> Many educational settings require full-time faculty to hold at least a master's degree.<sup>8</sup> Careers in academia require skills and knowledge that are not included in entry-level dental hygiene programs, which establishes the necessity for more baccalaureate and masters level dental hygiene programs.<sup>8,9</sup> The conversion of existing associate degree dental

hygiene programs to baccalaureate degree is also needed to address the dental hygiene educator shortage.<sup>8</sup>

### Compensation

Compensation differences between private practice and dental hygiene educators may be a reason for the dental hygiene faculty shortage.<sup>8</sup> Some educational settings offer salaries lower than what practicing dental hygienists earn, which may result in fewer dental hygiene graduates pursuing careers in education.<sup>9</sup> New graduates prefer clinical practice over academia because the remuneration in education is inadequate to cover their outstanding debt loads.<sup>6</sup> Disclosures of benefits not available to practicing dental hygienists, such as predictable

and stable income, extended time off, retirement and paid medical and dental insurance, should be offered to prospective educators.<sup>6</sup> Academia offers a stimulating intellectual environment, satisfaction from teaching, textbook writing, lecturing, patentable research, continued education and faculty practice opportunities.<sup>4,6</sup> Undergraduate dental hygiene students should be supplied with information about how graduate education can lead to faculty positions and potential paid memberships to ADEA and the American Dental Hygienists' Association, continuing education, uniform allowances and malpractice and licensure fees.<sup>8,9,11</sup>

### Diversity

The lack of diversity among faculty may contribute to the lack of diversity among dental hygienists. Ninety-four percent of full-time baccalaureate dental hygiene faculty members are Caucasian, and 96% are female.<sup>8</sup> Eighty-nine percent of dental hygiene program directors (n=203) reported 0 to 5% of the student population were male, and 21% were minorities.<sup>5</sup> Suggestions to recruit minorities include using television, radio and print media to recruit diverse ethnic, racial and gender groups.<sup>8</sup>

ADEA formed the Center for Equity and Diversity and the Section on Minority Affairs to advance diversity in dental professions, develop comprehensive strategies to increase minorities in dental professions and invite various presidents of organized dentistry and dental hygiene to define and discuss minority issues.<sup>12</sup> Organizations such as the National Dental Association and the National Dental Hygienists' Association represent African American dental professionals and serve as a recruitment tool for minorities in the dental professions.<sup>13,14</sup>

### Mentoring

Health care professions have defined a mentor as a person who guides another by being a teacher, role model, advisor, counselor and coach.<sup>15-18</sup>

Advancement of the less experienced individual's personal and professional life is a recurring premise of mentoring.<sup>15-20</sup> Thorpe and Kalischuk developed the Collegial Mentoring Model for nursing, described as a friendship-based, collegial relationship promoting honest and open communication over an extended period of time.<sup>18</sup> A case-based analysis by Glickman et al discusses mentoring as 1 of 3 human relations fundamentals, along with motivating people and performance counseling.<sup>21</sup> Mentors must possess special qualities such as experience, commitment to the role as mentor, acceptance, guidance and nurture of the protégé, being approachable, good interpersonal skills, a sense of self-confidence, faculty camaraderie, generosity, competence and a commitment to the mentor/protégé relationship.<sup>16,20,22</sup>

Reviewing the literature revealed that the nursing profession utilizes mentoring in several different venues, from mentoring the neophyte faculty member, utilizing the College Mentoring Model for peer mentoring, to mentoring interested undergraduate students towards a career in academia.<sup>16,19,23,24</sup> Dental educators use mentoring in the same manner as nurses.<sup>21,25-27</sup>

Although research demonstrates the benefits of mentoring and the continued need for formal or informal mentoring of faculty members, the existing dental hygiene publications related to mentoring focus on faculty development of academic careers or research, and not faculty recruitment and retention.<sup>15,16,19,21,28-31</sup> Blanchard and Blanchard indicated 26% of dental hygiene programs were actively pursuing student mentorship to facilitate student transitions into clinical practice or other career fields.<sup>32</sup>

Obstacles dental hygiene faculty encountered were lack of formal structure and evaluation of the mentoring experience, variable mentor quality, lack of resources and inadequate support.<sup>32</sup> Dental hygiene faculty are receptive to mentoring their undergraduates, but reported inadequate time in the existing curriculum,

lack of faculty to administer the program, lack of mentor volunteers, no perceived need for implementation and heavy workload as reasons for not implementing a formal mentoring program.<sup>31,32</sup> Results from one survey revealed divisions in opinion regarding the addition of formal mentoring programs, with 43% (n=43) in favor and 54.4% either opposed (n=36) or answering "maybe" (n=20).<sup>32</sup> Interestingly, a similar survey of dental hygiene program directors indicated a positive correlation between length of mentoring experiences of the director and job satisfaction.<sup>31</sup>

The importance of influencing undergraduate students towards an academic career is a recurring theme in the literature when considering mentoring as a solution to the dental hygiene faculty shortage.<sup>16,20,22,27,28,32-36</sup> Barnes noted that recognizing and mentoring undergraduate students and promoting the pursuit of a career in academia should be used as a recruitment tactic for new faculty.<sup>33</sup> A survey of Canadian dental hygiene faculty regarding suggestions and topics for attracting new faculty included responses such as peer teaching, role modeling, mentoring, providing information about higher education, advertisement of higher education dental hygiene programs, courses discussing career options and encouragement of students toward pursuing academic careers.<sup>29</sup>

### Role Modeling

Since students' perceptions about dental hygiene faculty becomes their beliefs, incidental learning about faculty life must be provided in a positive light, hopefully inviting students towards an academic career.<sup>23,28,34</sup> Rosenfield notes modeling is a double-edged process, not entirely in the control of the faculty member. A difference in practicing dental hygienists and dental hygiene faculty may influence the perception of students. Dental hygiene students might perceive themselves as resembling dental hygienists in private practice instead of dental hygiene faculty.<sup>28</sup>

Another reason students feel they

don't resemble dental hygiene faculty is the difference in age between dental hygiene faculty and students. Bertolami et al makes the point that a mentor/role model loses effectiveness if they are significantly older than their protégé.<sup>34</sup>

The educators affecting dental hygiene students may be projecting the message that dental hygiene education is not interesting, important or fun. The effects frustrated faculty have on students are noted in Trotman's study of dental students (n=30).<sup>35</sup> The student interviews revealed few examples of full-time faculty that made academic careers look attractive. Students perceived there was no incentive for teaching, and full-time faculty were pulled in too many directions while part-time faculty were viewed more as role models.<sup>35</sup>

A survey evaluating the emerging workforce of nurses' (early to late 20s) preferences for faculty compared to responses from the entrenched nursing workforce (between ages 40 and 68) suggests a divide in faculty perception of students' preferences for faculty behavior. The top 3 answers of the well-established nursing workforce were clinical competence, approachability and a caring attitude, while emerging nurses listed approachability, good communications skills and professional attitude, respectively.<sup>36</sup>

### **Awareness**

A potential cause of the current dental hygiene faculty shortage may be a lack of awareness of the problem, as well as a lack of perceived opportunities, especially among students enrolled in undergraduate dental hygiene programs.<sup>11,37</sup> To create awareness of this issue, students should have the opportunity to explore career opportunities outside of the traditional curriculum, which typically directs students towards private practice.<sup>11</sup> With most dental hygiene programs, there is evidence of a lack of emphasis on encouraging careers in academia, and students only have an abstract concept of teaching and

research.<sup>11</sup> When dental educators ask dental students to consider academic career aspirations, they are encouraging them to make a career decision completely different from their initial career plan of clinical practice.<sup>34</sup>

Imprinting students early with the idea of becoming an educator and assisting in financing their education can enhance recruitment of future educators. In addition, educators should try to attract individuals who are interested in teaching as a moral vocation, with the goal of encouraging a career that may not be as lucrative, but more satisfying on a personal level.<sup>34</sup>

Students do not choose academic paths for various reasons. Financial compensation, the lack of interest in academia from the educational culture and students inability to make long term career decisions are all contributing factors.<sup>38</sup> Students do not possess the knowledge or information necessary to make an informed decision to pursue a career in education.<sup>39</sup>

Evidence suggests the dental profession as a whole does a good job of promoting the benefits of private practice, but this message is not conveyed regarding an academic career.<sup>38</sup> Solutions exist to help address the lack of encouragement to pursue a career in academia. One solution would be to implement programs promoting both research and academic careers. Elective courses allowing students to experience teaching, including developing their own "micro course," gives students exposure to a career in academia. An elective course, "Hands on Experience of Future Dental Educators," was offered as an apprentice teaching experience at the UCLA School of Dentistry in 2000. Based on the feedback of student teachers (n=21) who participated in the elective course, the majority indicated it was a positive and rewarding experience. All but 1 of the student teachers indicated they would like to incorporate teaching into their future plans. This study suggests the positive impact of the student teaching experience and could be incorporated into dental hygiene curricula.<sup>37</sup>

The ADEA task force on the Status of Allied Dental Faculty argued dental hygiene faculty shortages, as well as demands for researchers, can be attributed to the small number of master's programs in dental hygiene.<sup>39-41</sup> The recommendations from the task force included the use of technology to maximize faculty resources, loan forgiveness incentives and alternate ways of rewarding faculty.<sup>39</sup>

### **Institutional Support**

Lack of institutional support through faculty development is another problem contributing to dental hygiene faculty shortages. Faculty development is crucial in promoting academic excellence.<sup>41-46</sup> Due to competing research and clinical priorities, medical and allied health education does not get the attention needed to improve teaching or encourage scholarships for education.<sup>43</sup> One approach utilized in several medical universities includes the implementation of formal faculty development programs.<sup>41</sup> These have been referred to as grass roots programs,<sup>47</sup> Medical Education Scholars Programs<sup>42</sup> and Academies.<sup>48</sup> Goals of these programs were to enhance teaching methods, promote the scholarship of teaching, enhance curriculum development, enhance assessments development, promote advising and mentoring and promote executive leadership skills.<sup>41-43,47,48</sup>

One such program used to address improving teaching and encouraging scholarship of education in the health sciences was conducted at West Virginia University.<sup>43</sup> Led by university administrators and a committee of teachers from the preclinical and clinical faculty programs from the schools of dentistry, medicine, nursing and pharmacy, a "cross-discipline Health Sciences Teaching Scholars Program" was developed.<sup>43</sup> Beginning as a weekly face-to-face program, this evolved into a combination online web course with 1 hour weekly face-to-face meetings. Results of the program indicated the online discussions encouraged thinking about the subject matter beyond the

classroom hours. Due to the availability of online access, learning was reinforced, and for the presenters of the online modules, web development skills were enhanced. As the program evolved, participation increased due to wide access of the internet, allowing greater flexibility for clinical faculty.

Other methods cited for faculty development include a 7-tier hierarchy developed by Ullian and Stritter, which includes individual activities such as self-assessment, observation of “exemplary practice” videotapes, shadowing experienced or exemplary teachers, being videotaped while teaching and receiving feedback, journal clubs, lunch-and-learn discussion groups, rewarding teaching effectiveness for new and junior faculty and tuition support for faculty to participate in graduate programs in education.<sup>45</sup>

The outcomes of these faculty development programs revealed an increase in enthusiasm for teaching, educational research, publications of educational abstracts, editorials, chapters and books and an increase in presentations about education at professional association meetings.<sup>46</sup> Although these faculty development programs have been successful, they

have not been encouraged in health sciences.<sup>48</sup> Inclusion of faculty development programs may ultimately result in improved teaching performance and better outcomes for students.<sup>49</sup>

## Conclusion

Methods to address the dental hygiene faculty shortage are multifaceted. A combination of a situational approach using the suggestions discussed in this paper may provide successful alleviation of the problem at individual institutions. Experimental programs addressing the recruitment of diverse faculty members are also needed. Information regarding dental hygiene students and mentoring is not readily available. Research is needed to assess current dental hygiene programs and their use of formal or informal mentoring programs, their implementation of the programs and their rate of success or failure. By creating awareness of the dental hygiene faculty shortage problem, identifying new approaches may become easier. Another step towards addressing the faculty shortage is to gain the acceptance and enthusiasm of entities willing to make the changes needed to alleviate the shortage. Although these approaches may be beneficial,

the need for additional research relating to the dental hygiene faculty shortage is necessary. It is critical for current faculty members to address the dental hygiene faculty shortage and encourage curriculum reform to aid the movement for faculty development and recruitment both within their dental hygiene programs and through their local dental hygiene associations. With increased knowledge of the approaches available to address the issue and action on the part of dental hygiene professionals, educators and institutions throughout the country, the dental hygiene faculty shortage may be alleviated in the future.

*Laura Z. Baus, RDH, BS, is currently working in private practice and pursuing an MDH from the University of Tennessee Health Science Center. Elizabeth O. Carr, RDH, BS, is an instructor of Dental Hygiene at The University of Mississippi Medical Center School of Health Related Professions. Rachel S. Ennis, RDH, BA, is currently working in private practice, and pursuing a Master of Dental Hygiene degree at the University of Tennessee Health Science Center.*

## References

1. White paper: increasing access to and utilization of oral health care services. Academy of General Dentistry [Internet]. 2008 [cited 2009 Oct 1]. Available from: <http://www.agd.org/files/newsletter/7025accesstocarewhitepaper7-31-08.pdf>
2. National call to action to promote oral health. U.S. Department of Health and Human Services [Internet]. 2003 [cited 2009 Jan 5]. Available from: <http://www.surgeon-general.gov/topics/oralhealth/nationalcalltoaction.html>
3. Oral health care: essential to health care reform. American Dental Education Association [Internet]. 2008 [cited 2009 Oct 9]. Available from: [http://www.adea.org/policy\\_advocacy/federal\\_legislative\\_regulatory\\_resources/Pages/OralHealthCareReform.aspx](http://www.adea.org/policy_advocacy/federal_legislative_regulatory_resources/Pages/OralHealthCareReform.aspx)
4. Ganley BJ, Sheets I. A strategy to address the nursing faculty shortage. *J Nurs Educ.* 2009;48(7):401-405.
5. Dental hygiene education program director survey executive summary. American Dental Hygienists' Association [Internet]. 2008 [cited 2009 Dec 2]. Available from: [http://www.adha.org/downloads/AD-exec\\_report-2008.pdf](http://www.adha.org/downloads/AD-exec_report-2008.pdf)
6. Haj-Ali R, Walker MP, Petrie CS, Steven J. Educational necessities to compensate for faculty shortage. *J Dent Educ.* 2007;71(4):511-515.
7. Weaver RG, Haden KN, Valachovic RW. Dental school vacant budgeted faculty positions, academic year 2002-03. *J Dent Educ.* 2004;68(5):574-580.
8. Collins MA, Zinskie CD, Keskula DR, Thompson AL. Characteristics of full-time faculty in baccalaureate dental hygiene programs and their perceptions of the academic work environment. *J Dent Educ.* 2007;71(11):1385-1402.
9. Majeski J. The dental hygiene educator shortage. *Access.* 2006;20(7):55-58.
10. American Dental Association Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs. American Dental Association [Internet]. 2007 [cited 2009 Jan 15]. Available from: <http://www.ada.org/sections/educationAndCareers/pdfs/dh.pdf>
11. Furgeson D, George M, Nesbit S, Peterson C, Peterson D, Wilder RS. The role of the student professional or-

- ganization in mentoring dental hygiene students. *J Dent Hyg.* 2008;82(1):9.
12. The ADEA Center for Equity and Diversity (CED). American Dental Education Association [Internet]. 2009 [cited 2009 October 9]. Available from: [http://www.adea.org/about\\_adea/governance/OnlineLeadershipGuide/Pages/ADEACenterforEquityandDiversity.aspx](http://www.adea.org/about_adea/governance/OnlineLeadershipGuide/Pages/ADEACenterforEquityandDiversity.aspx)
  13. National dental association profile: a history. The National Dental Association [Internet]. 2009 [cited 2009 Oct 8]. Available from <http://www.ndaonline.org/nda-profile>
  14. National dental hygienists' association mission statement. The National Dental Hygiene Association [Internet]. 2009 [cited 2009 Oct 10]. Available from <http://www.ndhaonline.org/aboutus.html>
  15. Yoder L. Mentoring: A concept analysis. *Nurs Adm Q.* 1990;15(1):9-19.
  16. Desjardins PJ. Mentoring during the transition from graduate student to faculty member. *J Dent Educ.* 1992;57(4):301-305.
  17. Fields WL. Mentoring in nursing: A historical approach. *Nurs Outlook.* 1991;39(6):257-261.
  18. Thorpe K, Kalischuk RG. A collegial mentoring model for nurse educators. *Nurs Forum.* 2003;38(1):5-15.
  19. Young CY, Wright JV. Mentoring: The components for success. *J Instructional Psych.* 2000;28(3):202-206.
  20. Smith JA, Zsohar H. Essentials of neophyte mentorship in relation to the faculty shortage. *J Nurs Educ.* 2007;46(4):184-186.
  21. Glickman GN, Comer RW, Filler SJ, Fine JB. Case I: managing people - the case of the frustrated faculty member. *J Dent Educ.* 2002; 66(4):520-525.
  22. Cangelosi PR. A lack of qualified faculty: one school's solution. *Nurs Educ.* 2004;29(5):186-188.
  23. Allen L. The nursing shortage continues as faculty shortage grows. *Nurs Econ.* 2008;26(1):35-40.
  24. Henson HA. Parallel professions: dental hygiene and nursing. *Contemporary Oral Hyg.* 2005;5(11):6-11.
  25. Livingston HM, Dellinger TM, Hyde JC, Holder R. The aging and diminishing dental faculty. *J Dent Educ.* 2004;68(3):345-353.
  26. Gates PE, Ganey JH, Brown MD. Building the minority faculty development pipeline. *J Dent Educ.* 2003;67(9):1034-1038.
  27. Flores-Mir C. Dental faculty shortage in the United States and Canada: are there solutions? *J Can Dent Assoc.* 2006;72(8):725-726.
  28. Rosenfield S. Academia: it's a wonderful life- isn't it? *School Psych Quart.* 2004;19(4):398-408.
  29. Mitchell TL, Lavigne SE. A survey of Canadian dental hygiene faculty needs and credentials. *J Dent Educ.* 2005;69(8):879-889.
  30. Lozier GG, Dooris MJ. Is higher education confronting faculty shortages? *J Higher Ed.* 1987;58:4-20.
  31. Barnes WG. The mentoring experiences and career satisfaction of dental hygiene program directors. *J Dent Hyg.* 2004;78(2):331-339.
  32. Blanchard SB, Blanchard JS. The prevalence of mentoring programs in the transition from student to practitioner among U.S. dental hygiene programs. *J Dent Educ.* 2006;70(5):531-535.
  33. Barnes WG. Distance education and the shortage of graduate degree dental hygiene faculty. *J Dent Hyg.* 2007;81(4):112.
  34. Bertolami CN. Creating the dental school faculty of the future: a guide for the perplexed. *J Dent Educ.* 2007;71(10):1267-1280.
  35. Trotman CA, Haden NK, Hendricson W. Does the dental school work environment promote successful academic careers? *J Dent Educ.* 2007;71(6):713-725.
  36. Wieck KL. Faculty for the millennium: changes needed to attract the emerging workforce into nursing. *J Nurs Educ.* 2003;42(4)151-157.
  37. Bibb CA, Lefever KH. Mentoring future dental educators through an apprentice teaching experience. *J Dent Educ.* 2002;66(6):703-9.
  38. Rupp JK, Jones DL, Seale NS. Dental students' knowledge about careers in academic dentistry. *J Dent Educ.* 2006;70(10):1051-1060.
  39. American Association of Dental Schools. Future of dental school faculty: report of the president's task force. Washington, D.C: American Association of Dental Schools (now American Dental Education Association), 1999.
  40. Wilder RS, Mann G, Tishk M. Dental hygiene directors' perceptions of graduate dental hygiene education and future faculty needs. *J Dent Educ.* 1999;63(6):479-488.
  41. Centra JA. Types of faculty development programs. *J Higher Educ.* 1978;(49):151-162.
  42. Gruppen LD, Frohna AZ, Anderson RM, Lowe KD. Faculty development for educational leadership and scholarship. *Acad Med.* 2003;78(2):137-141.
  43. Fidler DC, Khakoo R, Miller LA. Teaching scholars programs: faculty development for educators in the health professions. *Acad Psychiatry.* 2007;31(6):472-478.
  44. Wilkerson L, Irby DM. Strategies for improving teaching practices: a comprehensive approach to faculty development. *Acad Med.* 1998;73(4):387-396.
  45. Ullian JA, Stritter FT. Types of faculty development programs. *Fam Med.* 1997;29(4):237-241.
  46. Hendricson WD, Anderson E, Andrieu SC, et al. Does faculty development enhance teaching effectiveness? *J Dent Educ.* 2007;71(12):1513-1533.
  47. Thomas PA, Wright SM, Kern DE. Educational research at John's Hopkins University School of Medicine: a grassroots development. *Acad Med.* 2004;79(10):975-980.
  48. Thibault GE, Neill JM, Lowenstein DH. The Academy at Harvard Medical School: nurturing teaching and stimulating innovation. *Acad Med.* 2003;78(7):673-668.
  49. Hafler JP, Lovejoy FJ Jr. Scholarly activities recorded in the portfolios of teacher-clinician faculty. *Acad Med.* 2000;75(6):649-652.

# Case Report

## A Case Study Associated with Oropharyngeal Cancer

Sandra J. Maurizio, RDH, PhD; Alicia L. Eckart, RDH, BS

### Introduction

A 59 year old Caucasian male presented to a university dental hygiene clinic for a pre-radiation and chemotherapy examination and prophylaxis in late August, 2007. Medical history revealed a recent diagnosis and surgical intervention for left tonsillar squamous cell carcinoma (SCC). The patient indicated he personally discovered a submental lump while shaving. He brought the lump to a medical doctor's attention in June during a previously scheduled routine office visit. The patient was initially prescribed antibiotics. After no improvement with antibiotic treatment, the physician referred the patient to an otolaryngologist, who subsequently referred him to a head and neck surgeon at a regional cancer center. A CAT scan performed on June 10, 2007 revealed an enlarged cervical chain of lymph nodes on the left side. Biopsy obtained from the area identified SCC of the tonsil. A CAT scan of the chest and radiographs of the thoracic spine revealed no evidence of metastasis. A modified radical neck dissection was performed on August 21, 2007.

The patient indicated he quit smoking cigarettes in April 2007, after 35 years of one pack per day tobacco use, with occasional efforts to quit. The patient reported no history of spit tobacco use. The patient consumed 2 to 6 alcoholic beverages per day. He continues to consume alcohol, but has reduced his intake to 2 to 3 alcoholic beverages 3 to 4 days per week. Dental history indicated sporadic dental treatment,

### Abstract

**Purpose:** Squamous cell carcinoma (SCC) is the most common oral malignancy, commonly located on the anterior floor of the mouth, lateral borders of the tongue, tonsillar pillars and lateral soft palate. A 59 year old male presented to a Midwestern university dental hygiene clinic following referral for pre-radiation and chemotherapy oral prophylaxis and comprehensive examination. He reported he found a firm lump in his neck and brought it to the attention of his general physician. Biopsy confirmed the diagnosis of SCC of the left tonsil. Surgery, radiation and chemotherapy were performed. This case study demonstrates the need to include careful palpation of lymph nodes in every intra- and extra-oral examination. Dental hygienists should document significant findings and notify the dentist of abnormalities and the need for subsequent referral, providing early detection results in improved prognosis for those who encounter experiences with oral, head and neck cancer. quent referral, providing early detection results in improved prognosis for those who encounter experiences with oral, head and neck cancer.

**Keywords:** Oral cancer, squamous cell carcinoma, tonsillar cancer, oropharyngeal cancer, radiation and chemotherapy, early detection

This study supports the NDHRA priority area, Clinical Dental Hygiene Care: Assess the use of evidence-based treatment recommendations in dental hygiene practice.

primarily limited to extractions. Other medical history findings were within normal limits.

Extra-oral examination revealed a 23 cm incision site originating inferior to the left auricular lobe, extending along the sternocleidomastoid muscle to the area immediately superior to the clavicle and lateral to the midline of the submental region (Figure 1). A full mouth intraoral radiographic survey demonstrated generalized chronic periodontitis and missing teeth (Figure 2).

Intra-orally, there was evidence of recent oropharyngeal surgery. A triangular portion of the soft palate and tonsillar pillar was missing on the patient's left side. A maxillary partial denture was present.

### Treatment

#### Preventive and Restorative Treatment

Following consultation with several dentists and dental hygienists, a maxillofacial surgeon, the dental hygiene student and the patient, a dental hygiene diagnosis was determined and a treatment plan was developed. The patient provided informed consent. Because the radiation oncologist would not initiate radiation therapy and chemotherapy until all dental treatment was completed, time was critical. The patient scheduled all preventive and restorative treatment during the 3 week period following the initial examination. The dentist extracted 2 teeth to avoid the possibility of

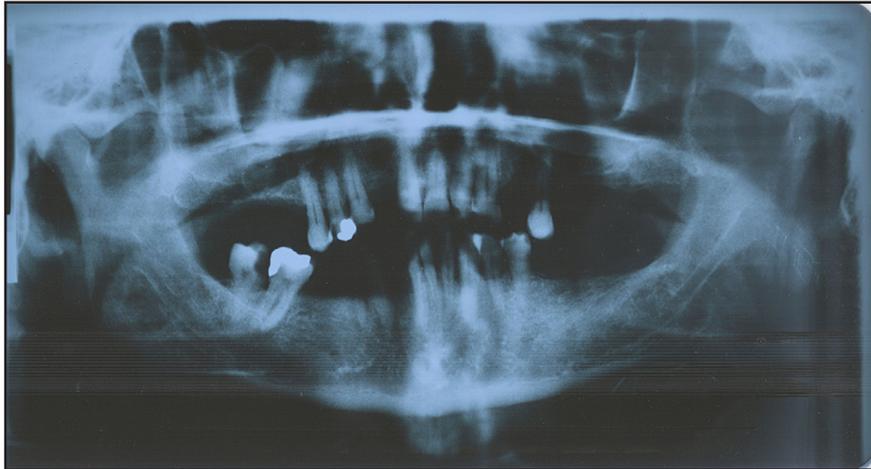
Figure 1



future osteoradionecrosis following radiation therapy.<sup>1-3</sup> All restorations were completed. The maxillary partial denture fit well and required no alterations. Additional intra- and extra-oral photographs were taken 1 month postoperative.

The student dental hygienist performed quadrant periodontal debridement under local anesthesia and provided oral hygiene instructions. Fluoride varnish was applied to exposed surfaces of the teeth. The student demonstrated to the patient correct flossing and brushing techniques using an extra soft toothbrush and suggested saliva substitutes such as Biotene® (Laclede, Inc., Dominguez, CA) or Oasis (Gebauer Consumer Healthcare, Cleveland, OH) to help alleviate xerostomia caused by radiation therapy. The student obtained alginate impressions, from which a custom tray of soft acrylic was constructed. The patient was given 1.1% neutral sodium fluoride gel and instructed on appropriate use. Instructions include placing a small amount of gel in the custom tray, applying the trays once daily for 5 minutes and refraining from eating or drinking for 30 minutes. Trays should be rinsed after use with room temperature water, air dried and placed in cool water for storage. The student recommended he apply the fluoride at the same time every day to help him incorporate the application into his daily routine, suggesting after breakfast, during bathing or before bedtime as options to make it easier and more comfortable to abstain from food and beverages for 30 minutes. Be-

Figure 2



cause patients often tolerate mild or flavorless fluoride better than those with strong flavors, a mild flavor was prescribed.<sup>4-6</sup> A casein phosphopeptides-amorphous calcium phosphate product was also prescribed with instructions to brush the gel on all surfaces of the teeth at least once per day.<sup>7</sup> These products saturate the tooth surface to assist in remineralization and are used in conjunction with other fluoride therapy products for individuals with high caries risk, such as those with xerostomia.<sup>7-9</sup>

Patient instructions included discussing the need to place removable appliances in denture solution overnight and the use of non-petrolatum-based lip products. Frequent re-evaluation appointments were stressed to alleviate any oral complications following treatment.<sup>10</sup>

During subsequent periodontal maintenance recalls, the patient's oral health was assessed. Light debridement was indicated. Gingival and periodontal health remained unchanged. Additional photographs were obtained to document the continued healing of the surgical site (Figures 3, 4).

### Surgical Intervention

The surgeon's operative report indicated he initially performed a laryngoscopy to examine the larynx and the base of the tongue, and to palpate the base of the tongue to determine the extent of the lesion. The larynx was normal. The tu-

mor extended from the soft palate, and included a portion above the uvula, both the anterior and posterior pillars and the inferior base of the tongue. The surgical procedure was accessed through the oral cavity. The surgeon removed the soft palate on the left side, the anterior and posterior tonsillar pillar, the tonsillar fossa, the triangular fossa and the base of the tongue up to the posterior pharyngeal wall. The surgeon performed a modified radical neck dissection on the left side.<sup>11-13</sup> The sublingual and submandibular glands, along with the tail of the parotid, were removed. All major nerves were spared.

A 1.7 cm tumor with a depth of 6 mm was identified. Metastasis to 3 of 29 lymph nodes to a maximum depth of 3.5 cm was present. Biopsy of all surgical margins indicated no evidence of malignancy.

The surgical specimen was examined by a pathologist. He diagnosed stage IV (T1/N2b/MX) SCC of the left tonsillar bed. T1 indicates the tumor is  $\leq 2$  cm. N2b indicates that metastasis in multiple ipsilateral lymph nodes were present, none  $> 6$  cm. MX indicates distant metastasis cannot be assessed from the specimen provided.<sup>14-15</sup> The tumor extended through the nodes into the left portion of the neck. Soft tissue metastasis was present and lymph node structure was completely obliterated. A maximum area of metastasis was 3.5 cm. Distant me-

tastasis could not be assessed from the specimen provided (however, as previously noted, a CAT scan of the chest and radiographs of the thoracic spine indicated no evidence of distant metastasis).

### Radiation and Chemotherapy

Advanced tumors of the oropharynx are generally treated with a combination of surgical resection and postoperative radiotherapy.<sup>1,16</sup> This patient received chemotherapy in addition to neck resection and radiotherapy. In September 2007, prior to initiation of radiation and chemotherapy, a gastric feeding tube was inserted to provide nutritional intake due to the expected development of mucositis and subsequent inability to orally consume food. Medical consultation indicated no need for antibiotic prophylaxis associated with dental treatment following gastric tube placement.

Radiation therapy and chemotherapy were administered concurrently beginning in October 2007. The patient received 30 treatments of Intensity Modulated Radiation Therapy (IMRT).<sup>1,17</sup> Advantages of IMRT include the ability to modify the radiation beam for the patient's specific anatomy and tumor shape to reduce the dose of radiation to normal tissues. IMRT helps preserve critical anatomical features like salivary glands, cochlea, eye, brain and spinal cord, while delivering the radiation dose.<sup>3,17-19</sup> The procedure utilizes a custom-made mesh mask with markings for the precise and consistent administration of radiation (Figure 5). The mask is positioned over the patient's face so the radiation dose is administered to the same location each time. The dose consisted of 210 Centigray (cGy), using a 9-field technique with a custom block using MLC blocking with 6 MV photon. A total of 6,300 cGy was delivered over a 7 week period from mid-October to the end of November. The patient indicated each treatment took about 15 minutes.

Chemotherapy consisted of 7 treatments of 69 to 71 mg of Cis-

Figure 3



Figure 4



Figure 5



platin and other components (Table I).<sup>20</sup> Concurrent radiation and chemotherapy are frequently prescribed following surgery for late-stage patients at increased risk for recurrence and low survival rate.<sup>15,19</sup> Extra-capsular extension and positive surgical margins in particular have demonstrated significant benefit from concurrent chemoradiotherapy.<sup>3</sup>

One dose of Aloxi® (palonosetron HCl) was administered each day of chemotherapy and for 2 days after therapy to avoid nausea and vomiting. A 5 mg prescription of Salagen® (pilocarpine hydrochloride) was prescribed orally 3 times a day during post radiation treatment to help alleviate dry mouth symptoms resulting from salivary gland hypofunction caused by the radiotherapy.<sup>17-21</sup> Radiation and chemotherapy were completed in late November 2007. The feeding tube was removed mid-January 2008.

### Side Effects Experienced

Radiation and chemotherapy combined create a more complicated situation for maintaining the patient's comfort, lifestyle and defense from infection.<sup>2</sup> The patient in this case study experienced many of the side effects frequently observed in

patients who receive radiation therapy, including pronounced fatigue, nausea, loss of appetite, diminished taste sensation, xerostomia, weight loss and overall flu-like symptoms throughout radiation and chemotherapy treatment<sup>2,3,21</sup> (Table II). He also endured radiation burns to the skin at the site of treatment. The patient experienced transient dysphagia, or difficulty swallowing, oral mucositis and esophagitis during treatment. During the months following radiation and chemotherapy, the patient's xerostomia, taste and appetite gradually improved.

Mucositis is an extremely painful condition that involves inflammation of the mucosal lining of the entire gastrointestinal tract.<sup>21-26</sup> It causes significant morbidity, including malnutrition and local and systemic infections, in addition to pain. Topical anesthetics, chewing on ice chips, consumption of liquid or soft foods and use of bland oral rinses

**Table I: Components of Chemotherapy for Case Study Patient<sup>20</sup>**

Drug	Dose	Purpose
Palonosetron (Aloxi™)	0.25 mg	Antiemetic to prevent acute and delayed chemotherapy-induced nausea and vomiting.
Diphenhydramine	25 mg	Antihistamine and anti-nauseant
Dexamethasone	20 mg	Anti-inflammatory; corticosteroid used systemically and locally to prevent chronic swelling; antiemetic.
Cimetidine (Tagamet®)	300 mg	Prevent upper GI bleeding in critically-ill patients; OTC to relieve heartburn or acid indigestion
Amifostine (Ethyol®)	500 mg	Protective agent for selective cells to reduce toxicities associated with radiation and chemotherapy, particularly xerostomia
Cisplatin (Platinol®-AQ)	69 – 71 mg	Antineoplastic agent used to treat a variety of cancers, including head and neck cancers
Magnesium Sulfate	1.5 gm	Electrolyte supplement used to treat and prevent hypomagnesaemia and cardiac arrhythmias; short-term treatment of constipation or soaking aid; anticonvulsant
Potassium Chloride	20 mEq	Electrolyte supplement used to Treat and prevent hypokalemia (deficiency of potassium in blood)
Mannitol	25 gm	Diuretic and/or I.V. fluid replacement.

serve as therapeutic regimens for oral mucositis.<sup>22</sup>

As previously mentioned, the patient had 2 extractions prior to radiation therapy. The risk of osteoradionecrosis is lower if dental extractions are completed prior to radiation and chemotherapy. Osteoradionecrosis is a complication following high dose radiotherapy for head and neck cancer.<sup>1-3,27-30</sup> Specific definitions vary, but the condition involves exposed irradiated bone tissue that fails to heal in the absence of residual or recurrent tumors. Most osteoradionecrosis occurs within 2 years of radiotherapy, but the risk remains for life.<sup>28</sup>

**Additional Biopsy and Surgery**

In March 2009, approximately 20 months after the original surgical procedure, a PET scan revealed a suspicious mass in the right tonsillar

region. Surgery was scheduled the following month. The right palatine tonsil was removed. The pathology report indicated lymphoid hyperplasia with no evidence of malignancy.

In April 2010, the patient complained of headaches and underwent an MRI of the brain, CT scan of the neck and PET/CT scans of the skull to thigh areas. All tests were negative for metastatic disease.

**Discussion**

SCC is the most common cancer associated with the oral cavity. It affects over 36,000 people annually in the United States and results in approximately 7,900 deaths.<sup>31</sup> Oropharyngeal cancer’s 5 year relative survival rates depend upon stage and vary from 57% for Stage I to 30% for Stage IV cancers.<sup>31</sup> Avoidance of various risk factors, as previously stated,

**Table II. Side Effects of Cancer Therapy**

Radiation Therapy	
Alterations in pigmentation of skin, including white patches (vitiligo) or tanning	
Loss of hair (alopecia)	
Subcutaneous changes	
	<ul style="list-style-type: none"> <li>• Telangiectasia (dilated capillaries or “spider veins”)</li> <li>• Fibrosis</li> <li>• Edema (swelling)</li> </ul>
Acute mucositis	
Xerostomia (hyposalivation or dry mouth) and changes in quality of saliva	
Candidiasis (fungal overgrowth)	
Hypogeusia, dysgeusia, or ageusia (partial loss, changes in perception, or complete loss of taste, respectively)	
Dental caries	
Osteoradionecrosis	
Soft tissue necrosis (mucosal ulcer)	
Chemotherapy	
Acute mucositis	
Xerostomia and changes in quality of saliva	
Hemorrhage	
Candidiasis	

decreases the chances of acquiring this type of cancer. In addition, early detection results in improved prognosis for those who develop oral, head and neck cancer.

SCC contributes to approximately 90% of all malignant tumors in the mouth and is the sixth most common cancer worldwide.<sup>31-32</sup> SCC can be defined as a malignant neoplasm of stratified squamous epithelial origin that exceeds normal growth and may invade surrounding or distant tissues.<sup>32</sup> The male/female ratio of oral and pharyngeal cancers is approximately 2:1. Men may develop oral and pharyngeal cancers more often than women because they may be

more likely to participate in risk factors associated with the etiology of oral, head and neck cancers such as tobacco use and heavy alcohol consumption.<sup>31,33</sup>

SCC is commonly located on the lower lip, however, within the oral cavity the primary locations include the lateral borders of the tongue, anterior floor of the mouth, tonsillar pillars and lateral soft palate.<sup>34</sup> Eleven percent of oral SCC lesions are located in the oropharynx region, including the base of the tongue and the tonsillar fossa, the area affected in this patient.<sup>35</sup> At this location, the cancer tends to metastasize to the regional lymph nodes first, and may clinically reveal an asymptomatic, ulcerated, firm lesion in the soft tissue.<sup>36</sup>

Major risk factors for oral cancer include tobacco use and excessive alcohol consumption. Although each is carcinogenic, tobacco and alcohol have a synergistic effect that creates a very susceptible environment for oral cancer.<sup>37,38</sup> Other risk factors include human papillomavirus subtype 16 (HPV-16), age over 40, low fruit/vegetable intake, race and ultraviolet light (lip cancer)<sup>37-39</sup> (Table III).

Although the cancer-inducing mechanism is unknown, HPV markers have been found in 20 to 75% of tonsillar cancers.<sup>40</sup> The overall prevalence of HPV in SCC of the head and neck region is 25%, with a prevalence of 36% in oropharyngeal carcinomas, 24% in oral carcinomas and 24% in laryngeal carcinomas.<sup>40</sup> The type of virus implicated in 87% of the HPV-positive oropharyngeal carcinomas is HPV-16.<sup>40</sup> Although conflicting studies exist, HPV-related oropharyngeal carcinomas have been implicated with sexual transmission.<sup>40,42-48</sup> Studies show a correlation between sexual behavior, such as younger age of first intercourse, multiple sex partners, oral-genital contact and the incidence of HPV-positive oropharyngeal cancer.<sup>40</sup> Women with HPV-related cervical cancer demonstrate a higher incidence of oral SCC, as do their partners.<sup>40</sup> Additional studies report concurrent HPV-related tonsillar

**Table III. Risk Factors Related to Oral and Oropharyngeal Cancers**

Risk Factor	Explanation
Tobacco Use	9 out of 10 oral cancer cases are heavy smokers, and the risk of developing these cancers is dependent on duration and amount.
Alcohol Consumption	Heavy drinking combined with using tobacco increases oral cancer risk by 100-fold. Seven of 10 patients with oral cancer are heavy drinkers.
Human Papillomavirus	Some types of HPV that can cause cervical cancer have been known to cause some oral and oropharyngeal cancers, especially HPV-16.
Age	Individuals older than 40 years are at greater risk for oral cancer.
Ultraviolet Light	Prolonged exposure to the sun may increase the risk of cancer on the lips.
Poor Nutrition	Patients lacking fruits and vegetables in their diet are at greater risk of cancer of the oral cavity and oropharynx.

carcinoma in 3 couples with DNA sequences that indicate infectious transmission.<sup>42,48</sup> Patients with cancers containing HPV tend to be younger and have better survival rates. It is postulated that the recent vaccines for the prevention of HPV-related diseases may impact the incidence of oral cancer, but the impact is not likely to appear for some time.<sup>40-41</sup> Currently, the vaccine is recommended for adolescent girls, and until males and older populations are included, diminished incidence of HPV-related oral cancer will not likely be apparent.<sup>40</sup> The patient described in this case study self-reported a negative HPV status, but the presence of HPV in his tumor tissue is unknown.

### Conclusion

Early detection of head and neck cancer is an important measure that can greatly decrease morbidity and mortality. Due to this patient's age, gender, tobacco and alcohol use, the health history provided a good indication that he may be at higher risk for oral, head and neck cancer. He was a prime candidate for developing oral cancer. Although this patient found his neck mass independently, it is critical that dental care providers perform thorough examinations with complete palpation of all areas of the

mouth, head and neck.<sup>27</sup> Lesions may not be readily apparent visually, but may be more easily detected through palpation. Because the incidence of young patients with no apparent risk factors is increasing, it is important to remember that oral cancer examinations should not be limited to high risk individuals. Failure to provide these simple, quick exams is inexcusable.

The case study portrayed the events surrounding a diagnosis of head, neck and oral cancer treatments taken by a team of physicians, surgeons, oncologists, dentists, professors, dental hygienists and dental hygiene students. Assessments were made by the dental team after surgery and prior to treatment to prevent side effects the patient may have suffered when undergoing radiation and chemotherapy. For example, the patient was advised and followed through with necessary extractions and restorations to prevent osteoradionecrosis and rampant decay. Products were dispensed to aid in salivary flow, and custom fluoride trays were fabricated to prevent xerostomia and radiation caries. In addition, the patient was monitored during radiation and chemotherapy for side effects and oral hygiene. This was especially important due to the high risk of patients quitting treatment due to

the discomfort of mucositis that often develops. After radiation and chemotherapy were completed, the patient was evaluated, treated to maintain oral status, obtain pictures and document changes. The patient has continued to follow up with periodontal maintenance visits at the clinic.

Treatment induced side effects can be greatly reduced or prevented when dental professionals are an integral part of the management team. Oral side effects caused by treatment are the major reason patients must temporarily halt their treatment protocols. It is estimated that 56% of infections that occur during treatment that result in the death of a patient originate in the oral cavity.<sup>20</sup> Therefore, it is imperative that dental professionals vig-

orously educate themselves and their cancer patients on the prevention and management of oral health before, during and after cancer treatment.

Dental hygienists must stress the importance of regular office visits, not only to prevent or maintain dental caries and periodontal disease, but also to prevent or detect oral cancer in the early stages. Providing information regarding risk factors of oral cancer is essential to allow the patient to adopt appropriate preventive measures. Upon finding suspicious areas, it is crucial to remain in contact with the patient to ensure he or she follows up on referral recommendations. It is our duty as members of the dental team to ensure that patients understand the importance of compliance

with treatment recommendations, including frequent maintenance visits, monitoring and evaluating oral health and taking proper action to prevent side effects. With little effort on the dental team's part, we can truly save lives.

*Sandra J. Maurizio, RDH, PhD, is an associate professor, Dental Hygiene, School of Allied Health, College of Applied Sciences and Arts, Southern Illinois University, Carbondale, Illinois; Alicia L. Eckart, RDH, BS is a 2008 graduate of Southern Illinois University Carbondale and currently works in private practice in Swansea, Illinois.*

## References

1. Ko C, Citrin D. Radiotherapy for the management of locally advanced squamous cell carcinoma of the head and neck. *Oral Dis.* 2009;15(2):121-132.
2. Sciubba JJ. Post-treatment issues in the head and neck cancer patient. *Support for People with Oral and Head and Neck Cancer.* 2009;19(3):1-3.
3. Haddad RI, Shin DM. Recent advances in head and neck cancer. *N Engl J Med.* 2008;359(11):1143-1154.
4. Eichmiller FC, Eidelman N, Carey CM. Controlling fluoride dosage in a patient with compromised salivary function. *J Am Dent Assoc.* 2005;136(1):67-70.
5. Chambers MS, Mellberg JR, Keene HJ, et al. Clinical evaluation of the intraoral fluoride releasing system in radiation-induced xerostomic subjects. Part 1: Fluorides. *Oral Oncology.* 2006;42:934-945.
6. Maurizio SJ. Oral cancer. In: Harris NO, Garcia-Godoy F, Nathe CN, eds. *Primary preventive dentistry.* 7th ed. Upper Saddle River (NJ): Pearson; 2009:67-98.
7. GC America. MI Paste™ protocol. [cited 2009 Feb 4]. Available from: <http://www.gcamerica.com/images/pdfs/MIPasteProtocols10806rev6.pdf>.
8. Ranjitkar S, Rodriguez JM, Kaidonis JA, Richards LC, Townsend GC, Bartlett DW. The effect of casein phosphopeptide-amorphous calcium phosphate on erosive enamel and dentine wear by toothbrush abrasion. *J Dent.* 2009;37(4):250-254.
9. Reynolds EC. Casein phosphopeptide-amorphous calcium phosphate: The scientific evidence. *Adv Dent Res.* 2009;21(1):25-29.
10. McClure D, Essary D, Gurenlian JR. A collaborative team approach for symptom management for head and neck cancer patients. *Grand Rounds in Oral-Systemic Medicine.* 2007;2(1):43-53.
11. Regezi JA, Sciubba JJ, Jordan RCK. *Oral pathology: Clinical pathologic correlations.* 5th ed. St. Louis, (MO): Saunders Elsevier; 2008:48-69.
12. Shah JP, Gil Z. Current concepts in management of oral cancer—surgery. *Oral Oncol.* 2009;45(4-5):394-401.
13. Pagedar NA, Gilbert RW. Selective neck dissection: A review of the evidence. *Oral Oncol.* 2009;45(4-5):416-420.
14. Stage Information for Oropharyngeal Cancer. National Cancer Institute [Internet]. 2009 [cited 2009 Feb 4]. Available from: [www.cancer.gov/cancertopics/pdq/treatment/oropharyngeal/HealthProfessional/page4](http://www.cancer.gov/cancertopics/pdq/treatment/oropharyngeal/HealthProfessional/page4).
15. van der Schroeff MP, Baatenburg de Jong RJ. Staging and prognosis in head and neck cancer. *Oral Oncol.* 2009;45(4-5):356-360.
16. Kademani D. Oral cancer. *Mayo Clin Proc.* 2007;82(7):878-887.
17. Grégoire V, De Neve W, Eisbruch A, Lee N, Van den Weyngaert D, Van Gestel D. Intensity-Modulated Radiation Therapy for head and neck carcinoma. *Oncologist.* 2007;12(5):555-564.
18. Bhide SA, Miah AB, Harrington KJ, Newbold KL, Nutting CM. Radiation-induced xerostomia: Pathophysiology, prevention and treatment. *Clin Oncol (R Coll Radiol).* 2009;21(10):737-744.
19. Tepper J, Krasna MJ, Niedzwiecki D, et al. Phase III trial of trimodality therapy with cisplatin, fluorouracil, radiotherapy, and surgery compared with surgery alone for esophageal cancer: CALGB9781. *J Clin Oncol.* 2008;26(7):1086-1092.
20. Wynn RL, Meiller TF, Crossley HL. *Drug information handbook for dentistry.* 11th ed. Hudson (OH): Lexi-Comp, Inc.; 2006:79-1184.
21. Calderbank S. A vital link: Oral health during cancer therapies (head and neck radiation and/or chemotherapy). *Support for People with Oral and Head and Neck Cancer.* 2006;16(5):1-3.

22. Manne DS. Oral mucositis and xerostomia: Challenging oral health conditions. Part I: Oral mucositis. *Access*. 2006;20(6):34-37.
23. Peterson DE, Bensadoun RJ, Roila F. Management of oral and gastrointestinal mucositis: ESMO Clinical Recommendations. *Ann Oncol*. 2008;19(Suppl. 2):ii122-ii125.
24. McGuire DB, Correa ME, Johnson J, Wienandts P. The role of basic oral care and good clinical practice principles in the management of oral mucositis. *Support Care Cancer*. 2006;14(6):541-547.
25. Keefe DM, Schubert MM, Elting LS, et al.. Updated clinical practice guidelines for the prevention and treatment of mucositis. *Cancer*. 2007;109(5):820-831.
26. Harris DJ, Eilers J, Harriman A, Cashavelly BJ, Maxwell C. Putting evidence into practice: Evidence-based interventions for the management of oral mucositis. *Clin J Oncol Nurs*. 2008;12(1):141-152.
27. Madrid C, Abarca M, Bouferrache K. Osteoradionecrosis: An update. *Oral Oncol*. 2010;46(6):471-474.
28. Lyons A, Ghazali N. Osteoradionecrosis of the jaws: Current understanding of its pathophysiology and treatment. *Br J Oral Maxillofac Surg*. 2008;46(8):653-660.
29. Goldwasser BR, Chuang SK, Kaban LB, August M. Risk factor assessment for the development of osteoradionecrosis. *J Oral Maxillofac Surg*. 2007;65(11):2311-2316.
30. Ben-David MA, Diamante M, Radawski JD, et al. Lack of osteoradionecrosis of the mandible after IMRT for head and neck cancer: Likely contributions of both dental care and improved dose distributions. *Int J Radiat Oncol Biol Phys*. 2007;68(2):396-402.
31. Cancer facts and figures 2008: Estimated new cases and deaths by sex, US, 2008. American Cancer Society [Internet]. 2008 [cited 2009 February 4]. Available from: <http://www.cancer.org/downloads/STT/2008CAFFfinalsecured.pdf>.
32. Scully C, Bagan J. Oral squamous cell carcinoma overview. *Oral Oncol*. 2009;45(4-5):301-308.
33. Oral cancer facts. Oral Cancer Foundation [Internet]. [cited 2009 Feb 18]. Available from: <http://www.oral-cancerfoundation.org/facts/index.htm>.
34. Epstein JB, Gorsky M, Cabay RJ, Day T, Gonsalves W. Screening for and diagnosis of oral premalignant lesions and oropharyngeal squamous cell carcinoma: Role of primary care physicians. *Can Fam Physician*. 2008;54(6):870-875.
35. Ward EC, van As-Brooks CJ, editors. Head and neck cancer: Treatment, rehabilitation, and outcomes. San Diego (CA): Plural Publishing; 2006. 13 p.
36. Bayon R, Wenig BL. Carcinoma of the tonsil and oropharynx. Support for People with Oral and Head and Neck Cancer. 2008;18(1):1-3.
37. Petti S. Lifestyle risk factors for oral cancer. *Oral Oncol*. 2009;45(4-5):340-350.
38. Warnakulasuriya S. Risk factors for oral cancer. *British Journal of Healthcare Management*. 2009;15(11):557-562.
39. Warnakulasuriya S. Global epidemiology of oral and oropharyngeal cancer. *Oral Oncol*. 2009;45(4-5):309-316.
40. Shillitoe EJ. The role of viruses in squamous cell carcinoma of the oropharyngeal mucosa. *Oral Oncol*. 2009;45(4-5):351-355.
41. Varvares MA, Manne DS. Oral cavity and oropharyngeal cancer: The role of high-risk human papilloma virus. *Access*. 2008;22(8):44-45.
42. Andrews E, Shores C, Hayes DN, et al. Concurrent human papillomavirus-associated tonsillar carcinoma in 2 couples. *J Infect Dis*. 2009;200(6):882-887.
43. Gillison ML, Chaturvedi AK, Lowy DR. HPV prophylactic vaccines and the potential prevention of noncervical cancers in both men and women. *Cancer*. 2008;113(10):3036-3046.
44. Scully C. Oral cancer; the evidence for sexual transmission. *Br Dent J*. 2005;199(4):203-207.
45. Campisi G, Giovannelli L. Controversies surrounding human papilloma virus infection, head and neck vs oral cancer, implications for prophylaxis and treatment. *Head Neck Oncol*. 2009;1(1):8.
46. Chaudhary AK, Singh M, Sundaram S, Mehrotra R. Role of human papillomavirus and its detection in potentially malignant and malignant head and neck lesions: updated review. *Head Neck Oncol*. 2009;1(1):22.
47. Sikora AG, Morris LG, Sturgis EM. Bidirectional association of anogenital and oral cavity/pharyngeal carcinomas in men. *Arch Otolaryngol Head Neck Surg*. 2009;135(4):402-405.
48. Haddad R, Crum C, Chen Z, et al.. HPV16 transmission between a couple with HPV-related head and neck cancer. *Oral Oncol*. 2008;44(8): 812-815.

## Association Between Dental Hygiene, Cardiovascular Disease Risk Factors and Systemic Inflammation in Rural Adults

Stephanie J. Frisbee, MSc; Christopher B. Chambers, BS; Jefferson C. Frisbee, PhD; Adam G. Goodwill, BS; Richard J. Crout, DMD, PhD

### Introduction

In 2000, the landmark United States Surgeon General's report on "Oral Health in America" defined oral health broadly, emphasizing that oral health is "integral to general health."<sup>1</sup> Despite important links between oral health and general health, oral diseases are common in the population, and public health and prevention efforts aimed at improving population dental health have lagged prevention efforts for other common, chronic health conditions. In adults, periodontal disease increases throughout adulthood from an estimated prevalence of approximately 40% for those aged 18 to 24 to more than 90% for those above the age of 75, with men and individuals with lower socio-economic status having higher prevalence.<sup>1</sup> Geographic disparities in oral health are particularly seen in areas of Appalachia, with West Virginia, Kentucky, Louisiana and Arkansas cited as having the highest percentage of adults older than 65 years of age without any natural teeth remaining.<sup>1</sup> Based on results from the Center for Disease Control's 2004 Behavioral Risk Factor Surveillance System, 42.9% of adults older than 65 years of age in West Virginia reported having had all natural teeth removed, and 37.5% reported having not been to a dentist or dental clinic in the past year, both the highest in the nation.<sup>2</sup>

Given known associations between oral and systemic health, persistent disparities in dental hygiene and oral health are of public health concern, especially given the implication for health outcomes related to other

### Abstract

**Purpose:** A growing body of epidemiologic evidence links oral health, periodontal disease and cardiovascular health. While underlying pathophysiologic mechanisms are unclear, several studies have suggested a sub-acute inflammatory state, also implicated in the etiology of cardiovascular disease. The objective of the current study was to investigate associations between self-reported dental hygiene (brushing, flossing, preventive care and overall dental health), cardiovascular disease risk factors and systemic inflammation.

**Methods:** 128 adults from 5 different rural counties in West Virginia participated in a comprehensive, community-based health screening that included anthropometric assessments, collection of a blood specimen and completion of a questionnaire about dental hygiene practices and oral health.

**Results:** Univariate analysis demonstrated multiple statistically significant associations between self-reported dental hygiene and cardiovascular disease risk factors and markers of systemic inflammation. In regression analysis, after controlling for demographic and cardiovascular disease risk factor covariates, self-reported dental hygiene demonstrated statistically significant and independent associations with adiponectin, fibrinogen, C-reactive protein (CRP) and cellular adhesion molecule-1 (sICAM-1).

**Conclusion:** This study demonstrated associations between dental hygiene and systemic inflammation, independent from BMI and blood cholesterol. Future studies should investigate whether periodontal-related systemic inflammation begins before the onset of clinical disease. Results from this and other studies highlight the importance of dental hygiene in overall systemic health, and are beginning to collectively suggest that regular dental hygiene care is an integral part of comprehensive health care.

**Keywords:** Oral health, dental hygiene, cardiovascular disease risk factors, systemic inflammation, rural health

This study supports the NDHRA priority areas, Health Promotion/Disease Prevention: Validate and test assessment instruments/strategies/mechanisms that increase health promotion and disease prevention among diverse populations, and Clinical Dental Hygiene Care: Investigate the links between oral and systemic health.

systemic chronic disease conditions. In particular, recent epidemiologic studies have reported relationships between cardiovascular health and oral health.

Mattila et al were among the first to report a link between dental health and acute myocardial infarction, dental infections and coronary atheroscle-

rosis and dental infections and acute myocardial infarctions.<sup>3-5</sup> These early reports were supported with similar findings from other investigators.<sup>6-11</sup> In attempting to identify an underlying mechanism for this association, studies have reported a relationship between the cumulative burden of periodontal pathogenic burden and coronary heart disease.<sup>12</sup> There have also been established links between periodontitis and elevated levels of systemic c-reactive protein (CRP) and IL-6,<sup>13</sup> and more recent studies have suggested that localized immune response to periodontal infection leads to elevated systemic inflammatory markers.<sup>14,15</sup>

While causative pathways between periodontal and cardiovascular disease have yet to be definitively established, there are important public and preventive health implications for the links between oral health and systemic inflammation. The understanding of the role of inflammation in cardiovascular disease has expanded rapidly in recent years.<sup>16</sup> If both systemic inflammation and vascular function can be improved with improved periodontal health, then by extension, prevention of poor periodontal health through dental hygiene and preventive dental care should lead to lower systemic inflammation and, ultimately, lower risk for poor cardiovascular health.

The purpose of this study was to investigate associations between self-reported dental hygiene practices, cardiovascular disease risk factors and systemic inflammation in adults living in rural communities. The hypothesis was that better dental hygiene practices and more frequent preventive dental care would be associated with more favorable levels of systemic inflammation.

## Methodology

### Participants

Participants were selected from 5 different counties in West Virginia. Counties ranged in rurality from 3 to 9 on the United States Department of Agriculture Economic Research Service 2003 Rural-Urban Continuum Codes (9 being the most rural). Multiple avenues of recruitment were used to invite participation in a comprehensive health

screening taking place in their community during the spring to fall months of 2006. Results reported here are from adult participants (older than 18 years of age at the time of their enrollment), thus representing a cross-sectional, convenience sample of adults from rural Appalachian communities. All methods and protocols were approved by the West Virginia University Institutional Review Board.

### Data Collection

Mobile data collection teams were stationed in community-based facilities for health screenings from 7 am to 11 am. Participants, having completed a fast of at least 8 hours, underwent standard anthropometric assessment that included height, weight, hip and waist circumference, estimated body fat using a hand-held body impedance meter (Omron HBF 300) and blood pressure (Omron HEM-711AC). All anthropometric measures were taken in duplicate and results were averaged for analysis. Participants provided a blood sample for determination of a fasting lipid profile and systemic inflammation, and blood glucose levels were determined immediately (FreeStyle Flash Blood Glucose Monitoring System). All participants also completed questions about health and lifestyle habits, and a structured questionnaire (14 questions) about their dental hygiene practices, preventive dental care and dental health. Many of these elements were also used as part of a multi-site study of dental health in Appalachia.<sup>17,18</sup> Of the 128 total participating adults, 115 (89.8%) completed the dental health survey.

### Biochemical Analysis

All physiologic samples were processed at the time of screening, with plasma fractions snap-frozen on dry ice. Plasma samples were analyzed in a nearby hospital laboratory to obtain a fasting lipid profile. Endocrine, cytokine and other inflammatory markers were obtained from frozen plasma using the Luminex200 system (Luminex Corporation, Austin, TX) with the appropriate Lincoplex<sup>®</sup> multiplex assay kits and protocols from LincoResearch (Millipore Corporation, Billerica MA).

Concentrations for all markers determined via the Luminex system were obtained in duplicate. Only concentrations with a coefficient of variation  $\leq 0.5$  were included. Blood samples were available from 120 of 128 participating adults. In considering blood sample availability, blood analysis data quality control procedures and survey response rate, 73 to 110 participants had complete data for inclusion in the analyses reported below.

### Statistical Analysis

For statistical analysis, questionnaire responses were evaluated and used to create a series of dichotomous categorical variables hereafter collectively referred to as "self-reported dental hygiene." Self-reported dental hygiene included measures of dental hygiene practices, attitudes, preventive care and overall dental health, all of which were self-reported by participants. Dental hygiene practices included the frequency of brushing (at least daily or less than daily) and frequency of flossing (2 to 6 times per week or less than weekly). Attitudes included the importance of dental health (very important, somewhat important or less) and dental fear (not at all afraid of the dentist, somewhat afraid or very afraid of the dentist). Preventive care included presence of a dental care home (dental health care home for regular dental care, or no dental health care home for regular dental care) and the frequency of preventive dental care (every 6 months, or less than annually). Finally, dental health included self-rated overall dental health (very good or better, or good or less than good).

Univariate analysis using Pearson's chi-square statistic was performed to identify statistically significant differences in self-reported dental hygiene based on participant demographic groups (gender, dental insurance, education and smoking). Univariate ANOVA analysis was performed to identify statistically significant (unadjusted) differences in cardiovascular disease risk factors and markers of systemic inflammation based on self-reported dental hygiene. All analyses reported focused on 3 cardiovascular disease risk factors: BMI (kg/m<sup>2</sup>), mean arterial pres-

sure ([two-thirds diastolic pressure + one-third systolic pressure] and total cholesterol (mg/dL)) and 6 markers of systemic inflammation (adiponectin (pg/mL), c-reactive protein (CRP, mg/dL), fibrinogen (ng/mL), interleukin-1 $\beta$  (IL-1 $\beta$ , pg/mL), soluble cell adhesion molecule-1 (s-ICAM-1, pg/mL) and tissue plasminogen activator inhibitor-1 (tPAI-1, pg/mL)).

To assess the robustness of associations between self-reported dental hygiene and systemic inflammation, multiple linear ordinary least squares (OLS) regression was performed. Regression permits the assessment of both the statistical significance and direction of the association between the dependent and predictor variable of interest after adjustment for, and so independent of, the effects of confounding (covariate) variables. In each OLS regression model reported, a marker of systemic inflammation was predicted (the dependent variable) by a self-reported dental hygiene variable, key demographic variables and a cardiovascular disease risk factor. For simplicity, all models included the same demographic variables (age, gender, smoking and dental insurance). All regression models (except for those models predicting CRP) also included a variable to adjust for indication of an acute infection (CRP $\geq$ 10 mg/dL, coded as a dummy variable). For regression models predicting CRP, only participants with CRP<10 mg/dL were included in the model. CRP $\geq$ 10 mg/dL is considered a marker of acute infection.<sup>19</sup> In total, regression models included 6 or 7 independent variables: 4 demographic variables, 1 cardiovascular disease risk factor and 1 self-reported dental hygiene variable. All models, except those predicting CRP, included a variable indicating presence of an acute infection. For all models, dependent variables were natural-log transformed to adjust for the effects of skewed distributions common to most biologic variables. Thus, the  $\beta$ -coefficient for the self-reported dental hygiene variable can be interpreted as the increase in systemic inflammation with every 1 unit increase in the self-reported dental hygiene variable after the effects of all other variables in the model have been

accounted for (that is, the “*ceteris paribus*” effect of self-reported dental hygiene on systemic inflammation).

Finally, as the vast majority of participants in the current study were genetically unrelated, statistical models did not require adjustment for potential sample autocorrelation or bias. There was no meaningful heteroscedasticity in any of the regression models. All statistical analyses were performed with SPSS (SPSS Inc., Chicago, IL).

## Results

The average age of the 128 participating adults was 41.5  $\pm$  9.3 (standard deviation) years. Sixty-two and a half percent of participants were women and 22.8% were smokers (a proportion similar to the West Virginia population).<sup>2</sup> Further, 52.5% of participants had more than a high school education and 70.2% reported having dental care covered as part of an insurance plan. Neither education nor dental insurance was different between men and women ( $p>0.05$ ).

Table I summarizes general characteristics of respondents with regard to self-reported dental hygiene. While the vast majority of respondents reported brushing daily (89.6%), a smaller proportion reported flossing at least multiple times weekly (55%) or receiving biannual preventive dental care (46.8%). Women had higher ratings for both fear of dental care and the importance of dental care ( $p<0.05$ ), with 27% reporting at least some fear of dental care and 58.3% reporting that preventive dental care was very important. Women reported flossing more frequently than men, but self-reported dental health was similar between men and women, with 43.8% reporting excellent or very good dental health.

While there was no relationship between education and dental insurance ( $p>0.10$ ), there was a univariate relationship between these variables and several measures of self-reported dental hygiene (Table I). As anticipated, having a dental care home and seeking biannual dental preventive care was related to having dental insurance, and biannual dental preventive care was related to education. Further, more fre-

quent brushing (but not flossing), less fear and higher rating of overall dental health was also related to higher levels of education. Smoking was related to the frequency of preventive dental care and self-reported overall rating of dental health. Smokers were less likely to seek biannual preventive dental care and more likely to rate their dental health as poor to good compared to non-smokers.

In Table II, univariate, unadjusted relationships (ANOVA analysis) between self-reported dental hygiene and cardiovascular disease risk factors and markers of systemic inflammation are summarized. Less frequent brushing was associated with elevated total cholesterol and less frequent flossing was associated with elevated mean arterial pressure. There was a trend toward an association between less frequent preventive dental care and higher mean arterial pressure, though this association did not achieve statistical significance ( $p=0.06$ ).

Also reported in Table II, self-reported dental hygiene was found to be statistically significantly related to multiple markers of systemic inflammation. In particular, less frequent brushing was associated with higher levels of IL-1 $\beta$  and a trend toward an associated higher level of tPAI-1 (brushing,  $p=0.093$ ). More frequent brushing and flossing were both associated with higher levels of adiponectin and higher levels of fibrinogen. Additionally, less frequent preventive care was associated with higher levels of sICAM-1 and a trend toward higher tPAI-1. Finally, better self reported, overall dental health was associated with lower levels of CRP and a trend toward lower sICAM-1 ( $p=0.055$ ), but higher adiponectin ( $p=0.091$ ).

Results from 15 separate regression models are shown in Table III. Specifically, the  $\beta$ -coefficients assessing the independent association between self-reported dental hygiene and a marker of systemic inflammation are reported. In 3 separate regression models (models 1 to 3), more frequent brushing was associated with statistically significantly increased levels of adiponectin independent of the effects of the demographic

variables and also after controlling for the effects of BMI, total cholesterol or mean arterial pressure.

Increased frequency of flossing was also associated with increased adiponectin (model 5), independent of the effects of the demographic variables and after controlling for total cholesterol. Further, in separate models (models 7 to 9), increased frequency of flossing was associated with increased levels of fibrinogen independent of the effects of the demographic variables and after controlling for BMI, total cholesterol or mean arterial pressure.

In unique regression models (models 10 to 12), increased frequency of preventive care was associated with lower levels of sICAM-1 independent of the effects of the demographic variables and after controlling for BMI, total cholesterol or mean arterial pressure.

Finally, in independent models, better overall dental health was associated with lower levels of CRP (models 13 to 15), unrelated to the effects of the demographic variables and after controlling for BMI, total cholesterol or mean arterial pressure. However, it was associated with a trend toward higher levels of adiponectin (models 16 to 18), independent of the effects of the demographic variables and after controlling for BMI or total cholesterol.

Several univariate associations between self-reported dental hygiene and systemic inflammation persisted after controlling for multiple covariates, including cardiovascular disease risk factors. Specifically, associations between increased frequency of brushing and flossing and increased adiponectin persisted after multiple adjustments in OLS regression analysis, as did associations between increased frequency of flossing and increased fibrinogen. Additionally, associations between increased frequency of preventive care and lower sICAM-1 and better overall dental health and lower CRP persisted after multiple adjustments in OLS regression analysis. Univariate associations between self-reported dental hygiene and IL-1 $\beta$  and tPAI-1 did not persist after multiple adjustments in OLS regression analysis.

## Discussion

This study investigated associations between self-reported dental hygiene, cardiovascular disease risk factors and systemic inflammation in adults living in rural communities. In both unadjusted (univariate) and adjusted (regression) analyses, this study demonstrated statistically significant and independent associations between self-reported dental hygiene and systemic inflammation.

The findings that frequent brushing (but not flossing), along with less fear and higher rating of overall dental health, were related to higher levels of education have been noted in previous studies.<sup>20</sup> The findings that women reported flossing more frequently than men are also consistent with previously reported findings.<sup>21</sup>

The results that indicate better overall dental health was associated with lower levels of CRP are consistent with multiple, previous studies. Earlier investigations have consistently reported that CRP, an acute phase protein, is associated with both aggressive and localized periodontitis, periodontal attachment loss and other metrics of periodontal health.<sup>13</sup> While in this cross-sectional study, the temporality of association cannot be established. Future studies should investigate whether elevations in CRP begin with poorer dental hygiene, with or without related periodontitis.

The observation that increased frequency of preventive care was associated with lower levels of sICAM-1 is consistent with recent studies reporting association between serum levels of cellular adhesion molecules<sup>26</sup> and sICAM-1, specifically in gingival crevicular fluid in patients with chronic periodontitis.<sup>27</sup> This observation is also consistent with our hypothesis that better dental hygiene practices would be associated with more favorable levels of systemic inflammation.

Results of this study illustrate that better self-reported dental hygiene was associated with higher levels of adiponectin. This is also consistent with previous studies that have reported higher levels of adiponectin in those with lower BMI.<sup>30,31</sup> While some studies have suggested a minimal role for adiponectin in periodontal related cardio-

Table I. Differences in Self-Reported Dental Health Status (n (%))

Dental Hygiene Practices	Frequency of Brushing	At Least Daily < Daily
	Frequency of Flossing	2-6 Times/Week Weekly or Less
Attitudes	Dental Health	Very Important Somewhat or Less
	Fear of Dentist	Not At All Some – Much
Preventive Care	Health Care Home	Has Dental Home No Dental Home
	Frequency of Preventive Care	Every 6 Months Annually or Less
Dental Health	Self-Rated Overall Health	Very Good or Better Poor – Good

\*p value for Pearson's Chi-Square.

†HS=High School

Table II. Univariate (ANOVA) Results for Systemic Inflammation

CVD Risk Factors	Frequency of Preventive Care	Frequency of Preventive Care
		At Least Daily
BMI (kg/m <sup>2</sup> )		
Total Cholesterol (mg/dL)		182.9 ±34.2
Mean Arterial Pressure		
Marker of Systemic Inflammation	Adiponectin (pg/mL)	1.3E4 ±4.6E3
	CRP (mg/dL) $\zeta$	
	Fibrinogen (ng/mL)	
	IL-1B (pg/mL)	1.5±1.6
	sICAM-1 (pg/mL)	
tPAI-1 (pg/mL)		1.8E4 ±9.6E3

$\zeta$ Analysis included only for those participants with CVD

\*p value for ANOVA F-statistic

# Reported Dental Hygiene Based on Gender, Dental Insurance, Education and Smoking

	Gender			Dental Insurance			Education			Current Smoker		
	Male	Female	p*	No	Yes	p*	≤HS†	>HS†	p*	No	Yes	p*
y	37 (86%)	66 (92%)	0.34	28 (85%)	71 (91%)	0.34	44 (83%)	59 (95%)	0.03	79 (92%)	20 (80%)	0.09
	6 (14%)	6 (8%)		5 (15%)	7 (9%)		9 (17%)	3 (5%)		7 (8%)	5 (20%)	
k	16 (40%)	44 (64%)	0.02	16 (53%)	42 (56%)	0.80	24 (48%)	36 (68%)	0.17	46 (55%)	12 (55%)	0.94
	24 (60%)	25 (36%)		14 (47%)	33 (44%)		26 (52%)	23 (43%)		37 (45%)	10 (45%)	
nt	18 (42%)	49 (68%)	0.01	18 (54%)	47 (60%)	0.58	28 (53%)	39 (63%)	0.28	54 (63%)	11 (44%)	0.09
	25 (58%)	23 (32%)		15 (46%)	31 (40%)		25 (47%)	23 (37%)		32 (37%)	14 (56%)	
r	37 (86%)	47 (65%)	0.02	23 (70%)	57 (73%)	0.72	32 (60%)	52 (84%)	0.005	61 (71%)	19 (76%)	0.62
	6 (14%)	25 (35%)		10 (30%)	21 (37%)		21 (40%)	10 (16%)		25 (29%)	6 (24%)	
h	34 (77%)	58 (80%)	0.67	22 (67%)	68 (86%)	0.02	42 (78%)	50 (81%)	0.70	72 (83%)	18 (72%)	0.23
	10 (23%)	14 (20%)		11 (33%)	11 (14%)		12 (22%)	12 (19%)		15 (17%)	7 (28%)	
hs	17 (39%)	35 (52%)	0.16	9 (29%)	41 (54%)	0.02	17 (34%)	35 (57%)	0.01	45 (55%)	5 (50%)	0.002
	27 (61%)	32 (48%)		22 (71%)	35 (46%)		33 (66%)	26 (43%)		37 (45%)	5 (50%)	
r	16 (37%)	33 (48%)	0.27	13 (39%)	34 (45%)	0.57	16 (30%)	33 (56%)	0.006	43 (50%)	4 (17%)	0.004
	27 (63%)	36 (52%)		20 (61%)	41 (55%)		37 (70%)	26 (44%)		42 (50%)	19 (83%)	

school

# Relationships Between Self-Reported Dental Hygiene and CVD Risk Factors and Systemic

Frequency of Brushing		Frequency of Flossing			Frequency of Preventive Care			Self-Rated Overall Dental Health		
<Daily	p*	2-6 Times/ Wk	Weekly or Less	p*	Every 6 Months	Annually or Less	p*	Excellent or Very Good	Poor-Good	p*
	p>0.10			>0.10			>0.10			>0.10
203.2 ±26.9	0.049			>0.10			>0.10			>0.10
	>0.10	96.3 ±9.3	102.4 ±11.8	0.003	96.9 ±11.2	101.3 ±12.7	0.06			>0.10
8.9E3 ±2.8E3	0.013	1.3E4 ±4.2E3	1.1E4 ±4.9E3	0.033			>0.10	1.3E4 ±4.5E3	1.2E4 ±4.6E3	0.097
	>0.10			>0.10			>0.10	2.7±2.2	4.1±2.7	0.017
	>0.10	4.2E6 ±1.3E6	3.4E6 ±1.2E6	0.004			>0.10			>0.10
2.8±3.1	0.029			>0.10			>0.10			>0.10
	>0.10			>0.10	201.1 ±68.8	268.2 ±110.4	<0.0001	216.7 ±90.1	253.6 ±101.5	0.055
2.4E4 ±1.8E4	0.093			>0.10	1.6E4 ±9.9E3	2.0E4 ±1.1E4	0.091			>0.10

CRP<10 mg/dL

**Table III. Multiple Regression Analysis Demonstrating Independent Associations Between Self-Reported Dental Hygiene and Systemic Inflammation**

Model	Dependent Variable	Cardiovascular Disease Risk Factor Adjustment (Dependent) Variable	Self-Reported Dental Hygiene (Dependent) Variable	n / $\beta \pm SE$ ; p
1†	Adiponectin	BMI	Frequency of Brushing‡	84 / 0.3±0.1; p=0.025
2†	Adiponectin	Total Cholesterol	Frequency of Brushing‡	82 / 0.3±0.1; p=0.019
3†	Adiponectin	Mean Arterial Pressure	Frequency of Brushing‡	82 / 0.3±0.1; p=0.022
4†	Adiponectin	BMI	Frequency of Flossing¥	p>0.1
5†	Adiponectin	Total Cholesterol	Frequency of Flossing¥	78 / 0.2±0.1; p=0.054
6†	Adiponectin	Mean Arterial Pressure	Frequency of Flossing¥	p>0.1
7†	Fibrinogen	BMI	Frequency of Flossing¥	90 / 0.2±0.1; p=0.008
8†	Fibrinogen	Total Cholesterol	Frequency of Flossing¥	88 / 0.1±0.1; p=0.028
9†	Fibrinogen	Mean Arterial Pressure	Frequency of Flossing¥	88 / 0.1±0.1; p=0.02
10†	sICAM-1	BMI	Frequency of Preventive Careψ	92 / -0.2±0.1; p=0.003
11†	sICAM-1	Total Cholesterol	Frequency of Preventive Careψ	90 / -0.2±0.1; p=0.01
12†	sICAM-1	Mean Arterial Pressure	Frequency of Preventive Careψ	90 / -0.2±0.087; p=0.005
13ζ	CRP	BMI	Self-Rated Overall Dental Healthξ	74 / -0.6±0.2; p=0.004
14ζ	CRP	Total Cholesterol	Self-Rated Overall Dental Healthξ	73 / -0.6±0.2; p=0.002
15ζ	CRP	Mean Arterial Pressure	Self-Rated Overall Dental Healthξ	73 / -0.6±0.2; p=0.002
16†	Adiponectin	BMI	Self-Rated Overall Dental Healthξ	82 / 0.2±0.1; p=0.062
17†	Adiponectin	Total Cholesterol	Self-Rated Overall Dental Healthξ	80 / 0.1±0.1; p=0.096
18†	Adiponectin	Mean Arterial Pressure	Self-Rated Overall Dental Healthξ	p>0.1

†Model also adjusted for age, gender, smoking, dental insurance, and acute immune response (CRP≥10)

ζModel adjusted for age, gender, smoking, and dental insurances; model included only participants with CRP<10 mg/dL

‡Coded as 0=Less Than Daily; 1=At Least Daily

¥Coded as 0=Less Than 2-6 Times Weekly; 1=At Least 2-6 Times Weekly

ψCoded as 0=Preventive Dental Care Annually or Less Frequently; 1=Preventive Dental Care Every 6 Months

ξCoded as 0= Overall Rating <Very Good (Poor-Good); 1= Overall Rating Excellent or Very Good

vascular disease,<sup>32</sup> current findings indicated that adiponectin increased with more frequent brushing and flossing. To the extent that elevated adiponectin can be considered cardioprotective (i.e., positively associated with good cardiovascular outcomes),<sup>33</sup> it may be that adiponectin functions as a correlate of positive health behaviors, such as those associated with lower BMI. It would be logically consistent to consider brushing and flossing as a positive health behavior and thus be associated with elevated levels of adiponectin. This observation is also consistent with our hypothesis that better dental hygiene practices would be associated with more favorable levels of systemic inflammation.

Results that show self-reported dental hygiene was associated with higher levels of fibrinogen suggest more complex relationships, and is the only observation that is not consistent with our

hypothesis that better dental hygiene practices would be associated with more favorable levels of systemic inflammation. Although fibrinogen levels have been positively correlated to age, smoking<sup>28</sup> and periodontal disease,<sup>29</sup> it is more difficult to explain the positive association in the increase in flossing. These findings warrant further study to determine if this finding is more generalizable or unique to the characteristics of this study, such as the sample or size.

### Conclusion

After controlling for variables with known, previous association with systemic inflammation, self-reported dental hygiene was significantly associated with more favorable levels of systemic inflammation, and thus suggests that dental hygiene may be independently contributing to systemic inflammation.

While previous studies have linked periodontal infection with systemic inflammation, and the link between dental hygiene and oral health is well established, from our literature search this is the first known study demonstrating an association between dental hygiene and systemic inflammation. Further, while previous studies have demonstrated that periodontal therapy and improved periodontal health can reduce markers of systemic inflammation in clinical populations,<sup>22-24</sup> results from the current study suggest similar associations in non-clinical populations. This study also extends previous observations of associations between self-reported oral hygiene behaviors in a clinical population of coronary heart disease patients.<sup>25</sup> Results from this study suggest that periodontal-related systemic inflammation may begin before the onset of clinical disease with poorer dental hygiene.

Future longitudinal studies should further investigate these findings.

### Limitations of the Current Study

This study has several limitations, and so requires cautious interpretation of results. As this is a cross-sectional study, results must be interpreted as associations, not causal relationships. The conservative criteria for inclusion of inflammatory markers in the final analysis limited the sample size, resulting in underpowered analyses, though all regression models were within the rule of thumb of 10 observations for each independent variable. It should also be noted that reduced sample size, combined with multicollinearity in regression models, work to bias toward accepting the null hypothesis of no effect, and so observed associations between dental hygiene and systemic inflammation are less likely to be attributable to type 1 error (false positive).

While participants in this study were generally healthy (i.e., a non-clinical population), they were voluntary participants in a health screening and are at least somewhat health conscious. They were resident in rural communities in a geographic area renowned for its poor health, dental and otherwise. While 70.2% of participants reported having dental insurance and 79.3% reported having a dental home, only 46.8% reported preventive dental care at least annually, a proportion lower than reported in the NHANES 1999-2004 study (59.9% for adults 20 to 64).<sup>34</sup> It is not well understood how issues related to access to care, socioeconomic concerns and cultural influences affect

dental health care seeking in the rural communities in this study, and if these influences and effects are generalizable to other populations. It is also unclear how issues such as lower rates of water fluoridation in rural communities may have affected the results reported here. Although 80% of publicly provided water sources in West Virginia are fluoridated,<sup>35</sup> it does not necessarily follow that 80% of the population in rural communities receive or ingest fluoridated water.

Finally, periodontal health was not directly evaluated, and measures of dental hygiene were self-reported. While a periodontal exam by a dental professional is clearly ideal, the challenges of such exams in epidemiologic and community-based studies, such as that reported, have been noted.<sup>36-38</sup> Recent studies have reported a reasonable clinical validity and reliability of self-reported measures for surveillance studies.<sup>37-38</sup>

### Implications of the Current Study

Results reported here will clearly benefit from additional studies in larger and more diverse populations. However, these initial results clearly highlight the importance of dental hygiene in overall, systemic health. Results reported here suggest that the effects of poorer dental hygiene may extend beyond poorer dental health to poorer systemic health, with the associations between dental hygiene and systemic inflammation of particular concern, given the known relationship between systemic inflammation and cardiovascular disease. The health policy implications from these

results are also potentially compelling, including the importance of the dentist and dental hygienist as an integral part of the health care team. Results from the 2005 BRFSS survey reported that 85.5% of Americans had some form of health insurance, but only 61.2% of Americans were estimated to have at least some dental insurance coverage (modular supplement to the 2001 BRFSS survey).<sup>2</sup> If results from future studies continue to suggest, as this and previous studies have, that dental hygiene and health is a key component to systemic health, our understanding of comprehensive health insurance may need to be revised to include mandatory coverage for dental care.

*Stephanie J. Frisbee, MSc, MA, PhD (Cand) is a Clinical Assistant Professor in the West Virginia University School of Dentistry Department for Rural Health and Practice, and a Research Instructor in the West Virginia University School of Medicine Department of Community Medicine. Christopher B. Chambers, BS, DDS, is a graduate of the West Virginia University School of Dentistry. Jefferson C. Frisbee, PhD, is an Associate Professor in the West Virginia University School of Medicine Department of Physiology and Pharmacology. Adam G. Goodwill, BS, PhD (Cand.) is a doctoral candidate in the West Virginia University School of Medicine Cellular and Integrative Physiology graduate program. Richard J. Crout, DDS, MS, PhD, is the Associate Dean for Research and Professor of Periodontics in the West Virginia University School of Dentistry.*

## References

1. U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health. 2000.
2. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2001, 2004, 2005 [Internet]. Available from: <http://www.cdc.gov/brfss/>.
3. Mattila KJ, Nieminen MS, Valtonen VV, et al. Association between dental health and acute myocardial infarction. *BMJ*. 1989;298(6676):779-781.
4. Mattila KJ, Valle MS, Nieminen MS, Valtonen VV, Hietaniemi KL. Dental infections and coronary atherosclerosis. *Atherosclerosis*. 1993;103(2):205-211.
5. Mattila KJ. Dental infections as a risk factor for acute myocardial infarction. *Eur Heart J*. 1993;14(Suppl K):51-53.
6. DeStefano F, Anda RF, Kahn HS, Williamson DF, Russell CM. Oral health, atherosclerosis, and cardiovascular disease. *BMJ*. 1993;306(6879):688-691.
7. Arbes SJ Jr, Slade GD, Beck JD. Association between extent of periodontal attachment loss and self-reported history of heart attack: an analysis of NHANES III data. *J Dent Res*. 1999;78(12):1777-1782.
8. Holmlund A, Holm G, Lind L. Severity of periodontal dis-

- ease and number of remaining teeth are related to the prevalence of myocardial infarction and hypertension in a study based on 4254 subjects. *J Periodontol.* 2006;77(7):1173-1178.
9. Elter JR, Champagne CM, Offenbacher S, Beck JD. Relationship of periodontal disease and tooth loss to prevalence of coronary heart disease. *J Periodontol.* 2004;75(6):782-90.
  10. Leivadaros E, van der Velden U, Bizzarro S, et al. A pilot study into measurements of markers of atherosclerosis in periodontitis. *J Periodontol.* 2005;76(1):121-128.
  11. Briggs JE, McKeown PP, Crawford VL, et al. Angiographically confirmed coronary heart disease and periodontal disease in middle-aged men. *J Periodontol.* 2006;77(1):95-102.
  12. Spahr A, Klein E, Khuseyinova N, et al. Periodontal infections and coronary heart disease: role of periodontal bacteria and importance of total pathogen burden in the Coronary Event and Periodontal Disease (CORODONT) study. *Arch Intern Med.* 2006;166(5):554-559.
  13. Loos BG, Craandijk J, Hoek FJ, Wertheim-van Dillen PM, van der Velden U. Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. *J Periodontol.* 2000;71(10):1528-1534.
  14. Buhlin K, Gustafsson A, Pockley AG, Frostegård J, Klinge B. Risk factors for cardiovascular disease in patients with periodontitis. *Eur Heart J.* 2003;24(23):2099-2107.
  15. Dye BA, Choudhary K, Shea S, Papapanou PN. Serum antibodies to periodontal pathogens and markers of systemic inflammation. *J Clin Periodontol.* 2005;32(12):1189-1199.
  16. Libby P. Inflammation and cardiovascular disease mechanisms. *Am J Clin Nutr.* 2006;83(2):456S-460S.
  17. Polk DE, Weyant RJ, Crout RJ, et al. Study protocol of the Center for Oral Health Research in Appalachia (COHRA) etiology study. *BMC Oral Health.* 2008;8:18.
  18. Marazita M, Weyant R, Tarter R, Crout RJ, McNeil D, Thomas J. Family-based paradigm for investigations of oral health disparities. *J Dent Res.* 2005;84(Spec Iss A):238.
  19. Pearson TA, Mensah GA, Alexander RW, et al. Markers of inflammation and cardiovascular disease: application to clinical and public health practice: A statement for health-care professionals from the Centers for Disease Control and Prevention and the American Heart Association. *Circulation.* 2003;107(3):499-511.
  20. Armfield JM, Spencer AJ, Stewart JF. Dental fear in Australia: who's afraid of the dentist? *Aust Dent J.* 2006;51(1):78-85.
  21. Khami MR, Virtanen JI, Jafarian M, Murtomaa H. Oral health behaviour and its determinants amongst Iranian dental students. *Eur J Dent Educ.* 2007;11(1):42-47.
  22. D'Aiuto F, Parkar M, Andreou G, et al. Periodontitis and systemic inflammation: control of the local infection is associated with a reduction in serum inflammatory markers. *J Dent Res.* 2004;83(2):156-160.
  23. D'Aiuto F, Parkar M, Nibali L, Suvan J, Lessem J, Tonetti MS. Periodontal infections cause changes in traditional and novel cardiovascular risk factors: results from a randomized controlled clinical trial. *Am Heart J.* 2006;151(5):977-984.
  24. D'Aiuto F, Parkar M, Tonetti MS. Acute effects of periodontal therapy on bio-markers of vascular health. *J Clin Periodontol.* 2007;34(2):124-129.
  25. Meurman JH, Qvarnström M, Janket SJ, Nuutinen P. Oral health and health behavior in patients referred for open-heart surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2003;95(3):300-307.
  26. Schenkein HA, Best AM, Brooks CN, et al. Anti-Cardiolipin and increased serum adhesion molecule levels in patients with aggressive periodontitis. *J Periodontol.* 2007;78(3):459-466.
  27. Hannigan E, O'Connell DP, Hannigan A, Buckley LA. Soluble cell adhesion molecules in gingival crevicular fluid in periodontal health and disease. *J Periodontol.* 2004;75(4):546-550.
  28. Krobot K, Hense HW, Cremer P, Eberle E, Keil U. Determinants of plasma fibrinogen: relation to body weight, waist-to-hip ratio, smoking, alcohol, age, and sex. Results from the second MONICA Augsburg survey 1989-1990. *Arterioscler Thromb.* 1992;12(7):780-788.
  29. Wu T, Trevisan M, Genco RJ, Falkner KL, Dom JP, Sempos CT. Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. *Am J Epidemiol.* 2000;151(3):273-282.
  30. Cnop M, Havel PJ, Utzschneider KM, et al. Relationship of adiponectin to body fat distribution, insulin sensitivity and plasma lipoproteins: evidence for independent roles of age and sex. *Diabetologia.* 2003;46(4):459-469.
  31. Berg AH, Scherer PE. Adipose tissue, inflammation, and cardiovascular disease. *Circ Res.* 2005;96(9):939-943.
  32. Iwamoto Y, Nishimura F, Soga Y, et al. Antimicrobial periodontal treatment decreases serum C-reactive protein, tumor necrosis factor-alpha, but not adiponectin levels in patients with chronic periodontitis. *J Periodontol.* 2003;74(8):1231-1236.
  33. Hopkins TA, Ouchi N, Shibata R, Walsh K. Adiponectin actions in the cardiovascular system. *Circ Res.* 2007;74(1):11-18.
  34. Dye BA, Tan S, Smith V, et al. Trends in oral health status: United States, 1988-1994 and 1999-2004. *Vital Health Stat 11.* 2007;248:1-92.
  35. Oral Health Data Systems - Oral Health Maps, 2007. Centers for Disease Control and Prevention [Internet]. Available from: <http://apps.nccd.cdc.gov/gisdoh/default.aspx>.
  36. Blicher B, Joshipura K, Eke P. Validation of self-reported periodontal disease: a systematic review. *J Dent Res.* 2005;84(10):881-890.
  37. Taylor GW, Borgnakke WS. Self-reported periodontal disease: validation in an epidemiologic survey. *J Periodontol.* 2007;78(7 Suppl):1407-1420.
  38. Jamieson LM, Thomson WV, McGee R. An assessment of the validity and reliability of dental self-report items used in a National Child Nutrition Survey. *Community Dent Oral Epidemiol.* 2004;32(1):49-54.

## Patients' Perception of Pain During Ultrasonic Debridement: A Comparison Between Piezoelectric and Magnetostrictive Scalers

Kelly A. Muhney, RDH, MS; Paul C. Dechow, PhD

### Introduction

The most commonly used ultrasonic devices for periodontal debridement are the piezoelectric and the magnetostrictive types. Both vary in design, operation and technique, and when selecting one for use, dental hygienists and clinicians should consider the advantages and disadvantages of each. Clinician comfort or preferences are factors to consider, but scientific findings and patient preference are of greater importance for evidence-based practice. One study reports that the use of piezoelectric scalers is more efficient in calculus removal than magnetostrictive scalers.<sup>1</sup> Several studies have examined root surface damage following the use of hand instruments and ultrasonic use, both with the piezoelectric and magnetostrictive types.<sup>2-7</sup> Less root surface roughness occurs with ultrasonic scalers than with hand scalers. Furthermore, consequential root surface roughness is dependent upon the ultrasonic unit's power settings, the lateral force and the shape and angulation of the working tip.<sup>5,6</sup>

Few studies demonstrate a decreased loss of root surface substance with use of the piezoelectric scaler compared with the magnetostrictive scaler.<sup>4,8</sup>

Assessments of the patient's pain during non-surgical periodontal therapy using different instrument delivery methods have been explored. Most research reports that patients experience more discomfort with hand instruments than with ultrasonic instrumentation.<sup>9,10</sup> A review of the literature revealed 2 research articles that reported less patient discomfort with

### Abstract

**Purpose:** To compare patients' perception of discomfort, vibration and noise levels between piezoelectric and the magnetostrictive ultrasonic units during periodontal debridement.

**Methods:** Periodontal debridement was performed on 75 subjects using a split-mouth design. Two quadrants on the same side were instrumented with a piezoelectric ultrasonic device (EMS Swiss Mini Master® Piezon) and the remaining 2 quadrants were instrumented with a magnetostrictive ultrasonic device (Dentsply Cavitron® SPS™). Subjects marked between 0 and 100 along a visual analog scale (VAS) for each of the 3 variables immediately after treatment of each half of the dentition. Scores of the VAS were compared using a nonparametric test for paired data, the Wilcoxon Signed-Rank test. The level of significance was set at  $p < 0.05$ . Descriptive statistics included the median and the first and third quartiles as a measure of variation.

**Results:** Mean scores for patient discomfort and vibration were greater for the magnetostrictive device at  $p = 0.007$  and  $p = 0.032$ , respectively. The scores for noise level between the 2 ultrasonic types were almost equal.

**Conclusion:** The results show that, on average, patients in this study prefer instrumentation with the piezoelectric as it relates to awareness of associated discomfort and vibration. The results of this study may assist the clinician in the decision over which ultrasonic device may prove more beneficial in decreasing patient discomfort and increasing patient compliance.

**Keywords:** scaling and root planing, piezoelectric, magnetostrictive, periodontal debridement, power driven scalers, calculus removal, ultrasonic scalers

This study supports the NDHRA priority area, Clinical Dental Hygiene Care: Assess the use of evidence-based treatment recommendations in dental hygiene practice.

the Vector™ magnetostrictive system than the conventional piezoelectric type.<sup>10,11</sup> Subjects from 2 studies reported little pain with either of the ultrasonic types.<sup>12,13</sup>

Operating differences between piezoelectric and magnetostrictive ultrasonic devices may account for pain intensity as experienced by the patient. Since heat is not generated within the piezoelectric handpiece, less water is required - this may alleviate some patient discomfort from gagging or mouth breathing. An added benefit is

that less time is spent on evacuation. In addition, the linear motion of the piezoelectric tip that moves parallel to the tooth surface while never losing contact may be less painful for the patient as opposed to the elliptical motion of the magnetostrictive scaler, which causes a "hammering" motion.

Traumatic dental or dental hygiene experiences may often decrease patient compliance with routine maintenance appointments. In 1969, the fear of dentists was documented as one of the 5 most common fears among

adults, and the tendency to avoid the dentist continues to prevail.<sup>14-17</sup> More current research reported that adults with high dental anxiety were significantly less likely to visit a dentist regularly than were adults with low dental anxiety.<sup>18</sup> Factors such as the sight and sound of certain instruments, the sensations or vibrations of certain instruments, perceived pain and actual pain or discomfort may increase a patient's anxiety level.<sup>11,19-22</sup> Furthermore, painful stimuli during ultrasonic debridement may increase blood pressure and heart rate for the duration of the treatment.<sup>23</sup> Patient compliance with regular prescribed periodontal maintenance is crucial in sustaining a healthy periodontium. Decreased noise, less sense of vibration and lowered subjective pain, combined with proficient clinical skills, correct ultrasonic technique and an appropriate ultrasonic device, may increase patient compliance, therefore restoring soft tissues to health and maintaining an inactive state of disease.

Minimal research has explored the differences in subjective pain intensity between the 2 ultrasonic types. The purpose of this study was to explore the levels of discomfort, vibration and noise as experienced by patients with periodontal disease during ultrasonic debridement therapy with both the piezoelectric and the magnetostrictive devices. The null hypothesis is that debridement using piezoelectric technology results in a similar level of discomfort when compared with magnetostrictive technology. The results of this study may influence dental hygienists' ultrasonic instrument selection during scaling and root planing procedures, especially when treating anxious patients or those with a low tolerance for pain. Results will provide the hygienist with information to make an informed decision among instrumentation types.

## Methodology

The Institutional Review Board of Baylor College of Dentistry independently reviewed and approved this study as it did conform to the pertinent rules and regulations regarding

the use of human subjects. The study was carried out with the full understanding of all participants who were provided with a verbal description of the study and a detailed informed consent.

### Sample

A convenience sample of Baylor College of Dentistry patients of record who were not on a routine periodontal maintenance schedule in the dental hygiene clinic were called to arrange a screening appointment to determine eligibility for this study. The parameters used to create this sample included those who had not received scaling and root planing in more than 6 months. For inclusion, patients met the following criteria:

- 18 years of age or greater, with an adequate level of English comprehension that allowed conversation between the dental hygienist and patient without the use of an interpreter
- A minimum of 12 natural, vital teeth in each right and left half of the mouth
- A clinical condition of either Case Type II Early Periodontitis, according to the American Dental Association (ADA) classification system,<sup>24</sup> and supragingival calculus covering the lingual surfaces of the mandibular anterior teeth and the buccal surfaces of the maxillary first molars with subgingival calculus ledges or rings
- Case Type III Moderate Periodontitis or Case Type IV Advanced Periodontitis 24 and supragingival calculus on the line angles or covering some of the lingual surfaces of the mandibular anterior teeth and maxillary buccal surfaces of the first molars with subgingival calculus spicules or ledges
- Similar amount and distribution of calculus on both right and left sides as assessed qualitatively on oral examination

The exclusion criteria for patients were:

- Dentinal hypersensitivity involv-

ing 1 or more teeth in each quadrant

- Non-vital teeth, large restorations or crowns involving several teeth in each quadrant.
- Any indication of acute necrotizing gingival and periodontal diseases
- Any pulpitis, abscesses, class V lesions or other acute dental infections requiring immediate treatment
- Any quadrant with a requirement of block anesthesia for a dental cleaning
- Any medical or psychological disorders that might affect pain threshold or current use of any prescription pain medication
- Any systemic disease that may preclude normal scaling procedures

### Procedure

The clinician and primary investigator, a licensed dental hygienist with 10 years experience using both piezoelectric and magnetostrictive ultrasonic units, was equipped with an auto-tune EMS Swiss Mini Master<sup>®</sup> Piezon scaler and an auto-tune Dentsply Cavitron<sup>®</sup> SPS<sup>™</sup> scaler. Debridement with the piezoelectric scaler was performed using the P tip on a low to medium power setting. Debridement with the magnetostrictive scaler was performed using the FSI #10 Universal tip using a low to medium power setting. The order for the split-mouth study was the magnetostrictive scaler on the first 37 patients and the piezoelectric scaler for the remaining 38 patients. The right side of the dentition was treated first with the assigned instrument, followed by the left side with the other instrument.

Subjects were not informed about the differences in each unit type. Each half of the mouth was scaled until all calculus was removed, a procedure lasting approximately 30 minutes. Following the completion of each side, subjects were asked to assess their level of discomfort (defined as pain), vibration and noise. Subjects used a horizontal, continuous interval scale, marking an "X" between

the left end (0, which indicated “no discomfort,” “no vibration” and “no noise,”) to the right end (100, which indicated “worst imaginable”). The hygienist performing the debridement was blinded to the visual analog scale (VAS) responses submitted by patients. Following debridement of each side, the hygienist presented the VAS to the subject and then stepped away from the dental operatory, at which time the survey was completed and placed immediately into a secured envelope by the subject. No discussion took place regarding any treatment experienced by the subjects.

### Data Analysis

A power analysis was conducted to calculate a sample size with  $\alpha=0.05$  and  $\beta=0.80$ . Seventy-five subjects were examined in order to detect a difference of 5 in the VAS for discomfort based on a standard deviation of 15, as estimated from similar studies in the literature. The entire  $\alpha$  was assigned to the discomfort measurement, with vibration and noise measurements considered as secondary questions. The scores were measured in millimeters along the scale from 0 to 100. Measurements were blinded as to device and all measurements were performed following the completion of the entire study. Scores of the VAS between each subject were compared using a nonparametric test for paired data, the Wilcoxon Signed-Rank test. Data were not normally distributed and thus required a nonparametric test. The level of significance was set at  $p<0.05$ . Descriptive statistics included the median and the first and third quartiles as a measure of variation. Post hoc tests compared patient subgroups based on periodontal involvement, gender, age range, ethnic group and tobacco use.

### Results

Table I provides the sample characteristics and demographics of the 75 subjects. The study participants included 56% males ( $n=42$ ), 44% females ( $n=33$ ) and 53.3% ( $n=40$ ) in the age range of 41 to 60 years old. Periodontal assessment using the ADA

classification system determined that 45.3% ( $n=34$ ) of subjects presented with Case Type II Early Periodontitis, 50.7% ( $n=38$ ) with Case Type III Moderate Periodontitis and 4% ( $n=3$ ) with Case Type IV Advanced Periodontitis.

As summarized in Table II, the results show a median of 20 (Q1-Q3: 9 to 44) for the magnetostrictive device compared to the piezoelectric device with a median of 14 (Q1-Q3: 5 to 34). Median vibration levels were 17 (Q1-Q3: 8 to 38) for the magnetostrictive device compared to 13 (Q1-Q3: 13 to 30) for the piezoelectric device. When subtracting the mean discomfort level of the piezoelectric from that of the magnetostrictive for each patient’s paired data, the result was a median of 3 (Q1-Q3: -3 to 20), which was different from the no effect value of 0 at level of statistical significance ( $p=0.007$ ). Likewise, the difference in medians for vibration showed a significance level of  $p=0.032$ , with a median of 5 (Q1-Q3: -7 to 16). No significance was found for noise level between the devices.

Figure 1 is a histogram that illustrates the differences in discomfort level for each patient as measured on the VAS. The difference for discomfort in the -10 to 10 point range includes 45.3% ( $n=34$ ) of subjects. Discomfort levels for 16% ( $n=12$ ) of the sample were below -10 indicating that this subgroup experienced greater discomfort with the piezoelectric device compared with 38.7% ( $n=29$ ) of the sample in which values were above 10, indicating greater discomfort with the magnetostrictive device.

Post-hoc analysis of differences between subgroups based on periodontal

Table I. Sample Characteristics by Percent (Number)  $n=75$

Periodontal Involvement	Early	45.3% (34)
	Moderate	50.7% (38)
	Advanced	4.0% (3)
Gender	Male	56.0% (42)
	Female	44.0% (33)
Age Range	20-40	22.7% (17)
	41-60	53.3% (40)
	61-89	24.0% (18)
Ethnic Group	Caucasian	57.3% (43)
	African-American	24.0% (18)
	Hispanic	10.7% (8)
	Asian	5.3% (4)
	Other	2.7% (2)
Tobacco Use (N=73)*	User	26.0% (19)
	Non-user	74.0% (54)

\*2 subjects unreported

involvement, gender, age range, ethnic group and tobacco use yielded no statistically significant results.

### Discussion

The results reject the null hypothesis that there is no difference in levels of discomfort during debridement with a piezoelectric ultrasonic device compared to a magnetostrictive device. More participants reported lower levels of pain with a piezoelectric device. The reported level of vibration was also lower for the piezoelectric device. These findings conflict with the current, limited number of similar studies which found that those subjects perceived less pain with a Vector™ magnetostrictive device than a conventional piezoelectric scaler.<sup>10,11</sup>

Thirty-four subjects (45.3%) in this study reported low levels of discomfort from both ultrasonic types, with values in the -10 to 10 range, which supports the Kocher studies.<sup>12,13</sup> If differences greater than 10% between devices are considered clinically significant, then the results show that 29 of 75 subjects (38.7%) preferred debridement with the piezoelectric instrument compared to 12 subjects (16.0%), who preferred the magnetostrictive device.

Some research has shown that

**Table II. Results by Quartile and Significance**

Reported Levels of: (0-100)*	Magnetostrictive (M) (mm)			Piezoelectric (P) (mm)			Difference (M-P) (mm)			Significance
	Q1	Median	Q3	Q1	Median	Q3	Q1	Median	Q3	p
Discomfort	9	20	44	5	14	34	-3	3	20	0.007
Vibration	8	17	38	4	13	30	-7	5	16	0.032
Noise	9	22	44	9	23	48	-13	1	19	NS

\*Scale of 0 (no discomfort, no vibration, no noise) to 100 (worst imaginable)

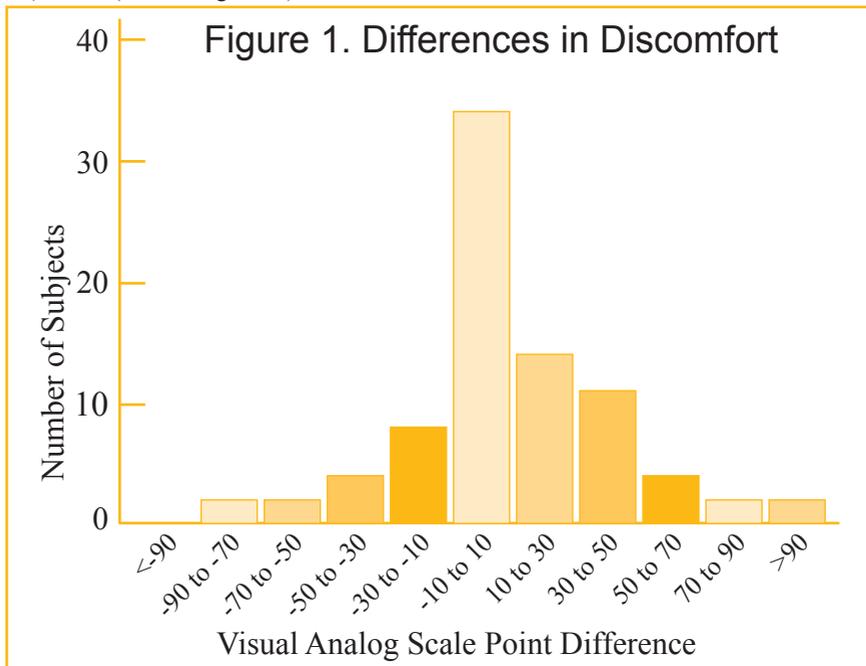
noise from mechanized instrumentation may increase patients' perception of pain.<sup>20,22</sup> However, when comparing the ultrasonic types in this study, this was not found, as the means for noise level were almost equal.

**Limitations and further research needs**

As with any study involving human subjects, some bias is expected, although the split mouth design used here and the blinding of the evaluation and analyses should alleviate much of the problem.

The participants may have recorded values on the scale in a way that would please the researcher, although this is doubtful, as the researcher was not present while patients filled out their evaluations. The scores used for statistical analysis were subjective and not objective measures of discomfort, vibration and noise. No recording gauge, such as a handheld digital manometer, was used during actual treatment when pain could have been recorded immediately. Subjects were asked only to assess retrospectively the levels of intensity after treatment was complete. Therefore, they may not have remembered precisely how intense a painful sensation and their recollection should be taken as an immediate summation of the total experience. No pressure gauge was connected to the clinician, and slight differences in lateral pressure during instrumentation may have occurred.

It is impossible to have a sample with an equal pain threshold or an equal acoustic sensitivity, and thus the split-mouth design is perhaps the only realistic way to conduct this study. Dental anxiety levels were not known - this may have had an effect on the pain sensation of individual subjects. The areas of distribution,



extent of calculus deposits and time spent for calculus removal varied slightly among subjects. The sample included adult persons of all ages and backgrounds who were all patients of record at Baylor College of Dentistry. Therefore, the results cannot be generalized to any one population.

Little research exists that compares subjective measures of pain during ultrasonic debridement between the piezoelectric and magnetostrictive devices. Future research might involve a random sample with equivalent characteristics and demographics. The study design could be improved through the use of a digital handheld device for the patient to indicate levels of pain intensity and a gauging device to insure equivalent instrument force during treatment.

**Conclusion**

Before the implementation phase of dental hygiene treatment, the dental hygienist or clinician should take into account the patient's comfort

level during periodontal debridement. The results of this study suggest that a significantly larger subgroup of patients prefer piezoelectric mechanized instrumentation as it relates to comfort level and decreased sensations of vibrations for periodontal debridement. An important factor in achieving successful treatment outcomes includes patient compliance and motivation. If the patient trusts that the dental team is providing therapy that considers individual needs for comfort, they may be more likely to continue a routine schedule and be proactive in the oral health care process.

*Kelly Muhney, RDH, MS, currently practices dental hygiene at a public health clinic, CommuniCare Health Centers, in Kyle, Texas. Paul C. Dechow, PhD, is Professor and Vice Chair of the Department of Biomedical Sciences at the Texas A&M Health Science Center Baylor College of Dentistry.*

## References

1. Busslinger A, Lampe K, Beuchat M, Lehmann B. A comparative in vitro study of a magnetostrictive and a piezoelectric ultrasonic scaling instrument. *J Clin Periodontol.* 2001;28(7):642-649.
2. Jacobson L, Blomlöf J, Lindskog S. Root surface texture after different scaling modalities. *Scand J Dent Res.* 1994;102(3):156-160.
3. Flemmig TF, Petersilka GJ, Mehl A, Hickel R, Klaiber B. Working parameters of a magnetostrictive ultrasonic scaler influencing root substance removal in vitro. *J Periodontol.* 1998;69(5):547-553.
4. Flemmig TF, Petersilka GJ, Mehl A, Hickel R, Klaiber B. The effect of working parameters on root substance removal using a piezoelectric ultrasonic scaler in vitro. *J Periodontol.* 1998;25(2):158-163.
5. Folwaczny M, Merkel U, Mehl A, Hickel R. Influence of parameters on root surface roughness following treatment with a magnetostrictive ultrasonic scaler: an in vitro study. *J Periodontol.* 2004;75(9):1221-1226.
6. Jepsen S, Ayna M, Hedderich J, Eberhard J. Significant influence of scaler tip design on root substance loss resulting from ultrasonic scaling: a laserprofilometric in vitro study. *J Clin Periodontol.* 2004;31(11):1003-1006.
7. Kawashima H, Sato S, Kishida M, Ito K. A comparison of root surface instrumentation using two piezoelectric ultrasonic scalers and a hand scaler in vivo. *J Periodontal Res.* 2007;42(1):90-95.
8. Cross-Poline GN, Stach DJ, Newman SM. Effects of curet and ultrasonics on root surfaces. *Am J Dent.* 1995;8(3):131-133.
9. Derdilopoulou FV, Nonhoff J, Neumann K, Kielbassa AM. Microbiological findings after periodontal therapy using curettes, Er:YAG laser, sonic, and ultrasonic scalers. *J Clin Periodontol.* 2007;34(7):588-598.
10. Braun A, Krause F, Nolden R, Frentzen M. Subjective intensity of pain during the treatment of periodontal lesions with the Vector-system. *J Periodontal Res.* 2003;38(2):135-140.
11. Hoffman A, Marshall RI, Bartold PM. Use of the Vector scaling unit in supportive periodontal therapy: a subjective patient evaluation. *J Clin Periodontol.* 2005;32(10):1089-1093.
12. Kocher T, Fanghänel J, Schwahn C, Rühling A. A new ultrasonic device in maintenance therapy: perception of pain and clinical efficacy. *J Clin Periodontol.* 2005;32(4):425-429.
13. Kocher T, Rodemerk B, Fanghänel J, Meissner G. Pain during prophylaxis treatment elicited by two power-driven instruments. *J Clin Periodontol.* 2005;32(5):535-538.
14. Agras S, Sylvester D, Oliveau D. The epidemiology of common fears and phobia. *Compr Psychiatry.* 1969;10(2):151-156.
15. Gatchel RJ, Ingersoll BD, Bowman L, Robertson MC, Walker C. The prevalence of dental fear and avoidance: a recent survey study. *J Am Dent Assoc.* 1983;107(4):609-610.
16. Abrahamsson KH, Berggren U, Carlsson SG. Psychosocial aspects of dental and general fears in dental phobic patients. *Acta Odontol Scand.* 2000;58(1):37-43.
17. Edmondson HD, Roscoe B, Vickers MD. Biochemical evidence of anxiety in dental patients. *Br Med J.* 1972;4(5831):7-9.
18. Sohn W, Ismail AI. Regular dental visits and dental anxiety in an adult dentate population. *J Am Dent Assoc.* 2005;136(1):58-66.
19. de Jongh A, Stouthard ME. Anxiety about dental hygienist treatment. *Community Dent Oral Epidemiol.* 1993;21(2):91-95.
20. Brand HS. Cardiovascular responses in patients and dentists during dental treatment. *Int Dent J.* 1999;49(1):60-66.
21. Karadottir H, Lenoir L, Barbierato B et al. Pain experienced by patients during periodontal maintenance treatment. *J Periodontol.* 2002;73(5):536-542.
22. Chung DT, Bogle G, Bernardini M, Stephens D, Riggs ML, Egelberg JH. Pain experienced by patients during periodontal maintenance. *J Periodontol.* 2003;74(9):1293-1301.
23. Brand HS, van der Wal JH, Palmer-Bouva CC, de Vries DR. Cardiovascular changes during subgingival debridement. *Int Dent J.* 1997;47(2):110-114.
24. Aguiar A. Periodontal disease recognition: A review course for dental hygienists. UCLA School of Dentistry [Internet]. [cited 2008 September 12]. Available from: <http://www.dent.ucla.edu/pic/members/pdr/classifications.html>.

## Early Childhood Caries: Knowledge, Attitudes, and Practice Behaviors of Maryland Dental Hygienists

Marion C. Manski, RDH, MS; M. Elaine Parker, RDH, PhD

### Introduction

Early Childhood Caries (ECC) is a rapid form of caries.<sup>1</sup> The Surgeon General's Report cites ECC as one of the most important public health diseases facing our nation.<sup>2</sup> This condition remains prevalent in young children of low socioeconomic backgrounds. Healthy People 2010 described ECC as affecting the primary teeth of infants and young children 1 to 6 years of age. ECC results in pain, trauma, health risks and costly treatment because of the nature of ECC on primary teeth.<sup>1</sup>

The etiology of ECC is multifactorial. Establishment of bacteria, behavioral and dietary practices, host specific factors, caregiver's oral health, enamel hypoplasia, preventive care, dental literacy and socioeconomic status (SES) all play a part in the development of ECC.<sup>3</sup> The bacteria associated with ECC are mutans streptococci (MS), which can be found as early as 12 to 24 months of age.<sup>4</sup> MS bacteria are acquired from the infant's caregiver, establishing that caries is transmissible and infectious.<sup>5</sup> The major reservoir of MS is the mother's saliva.<sup>6</sup> Infants and toddlers are at a greater risk of acquiring MS when the mother has high levels of MS because of untreated carious lesions.<sup>7</sup> MS bacteria is only one of a number of potential etiological agents involved in ECC.

ECC differs from general dental caries in that this particularly invasive form of caries begins not on pits and fissures, but on smooth surfaces such as the labial, lingual and proximal surfaces of primary maxillary

### Abstract

**Purpose:** Early Childhood Caries (ECC) is a rapid and rampant form of dental caries that can compromise a child's self esteem, nutritional intake, oral development and quality of life. ECC affects approximately 20% of American infants and toddlers annually. The purpose of this study was to determine dental hygienists' knowledge, attitudes and practice behaviors regarding ECC.

**Methods:** Seven hundred and fifty randomly sampled licensed Maryland hygienists were surveyed using a mailed questionnaire consisting of 42 items including knowledge, attitudes and practice behaviors of dental hygienists related to ECC. A 41% response rate was achieved (n=308). To assess differences in knowledge, attitudes and practice behaviors among Maryland hygienists, characteristics such as age, degree earned, years since graduation, primary practice type, percentage of children in practice, percentage of Medicaid patients treated, hours practiced and membership status in the American Dental Hygienists' Association were included.

**Results:** Knowledge of ECC and the current use of appropriate treatment protocols were mixed. Practicing Maryland dental hygienists were correct only 50 to 60% of the time. In addition, results show that treating more children enrolled in Medicaid made it more likely that hygienists knew about the appropriate timing of the first dental visit and its relationship to ECC. Results also show that dental hygienists with more experience were more likely to know of the appropriate treatment protocols than hygienists with less experience.

**Conclusion:** The study results suggest that certain characteristics of dental hygienists do make a difference in knowledge, attitudes and practice behaviors about ECC. This baseline study also reveals that there is a need to enhance dental hygienists' knowledge, attitudes and prevention efforts about ECC through further education courses.

**Keywords:** Early childhood caries, access to care, Dental Hygienists, oral health

This study supports the NDHRA priority area, Health Promotion/Disease Prevention: Investigate how diversity among populations impacts the promotion of oral health and preventive behaviors.

incisors, and proceeds rapidly to involve the molars and canines.<sup>8</sup> Behavioral practices influencing ECC are difficult to change. Dietary practices that include frequent and continuous ingestion of liquids containing fermentable carbohydrates bathe

the smooth surfaces of the teeth. Frequent bottle feeding at night, breastfeeding on demand and continuous use of "sip" cups increase the risk of ECC. Changing feeding practices is a difficult task. Most mothers follow the patterns their mother used, thus

carrying on such practices as bottle feeding or feeding on demand.<sup>8</sup> Early intervention programs targeting parents of young children at risk may reduce the number of children experiencing ECC.<sup>9</sup> Prenatal programs targeting expectant mothers may also reduce the number of children experiencing ECC.<sup>10</sup>

SES has been identified as the most significant predictor of ECC.<sup>11</sup> Children of low SES who are unable to access dental care are at the greatest risk for developing ECC, and mothers from low SES levels are often unable to care for themselves or their children because they lack the material, social and financial access to care.<sup>12</sup>

The American Academy of Pediatric Dentistry and the American Academy of Pediatrics recommend that the first dental visit should be on or before the infant's first birthday.<sup>13,14</sup> Primary prevention should begin prenatally and continue with screening of both mother and infant.<sup>6</sup> This will enhance the establishment of a dental home before birth and possibly reduce the incidence of ECC.

Fluoride varnishes and the use of chlorhexidine have been shown to be effective in the treatment of ECC. Research shows that applying fluoride varnish is effective in reducing ECC in children 9 to 42 months old.<sup>15</sup> Adding fluoride varnish in conjunction with caregiver counseling is recommended as effective in reducing ECC.<sup>16</sup> Varnish is the fluoride of choice for this young population, because of its lengthy retention time, ease of application, low ingestion potential and superiority to other topical fluoride applications.<sup>11,17</sup> Fluoride varnish is considered an "off label" use by the Food and Drug Administration (FDA) for caries prevention, however, the FDA considers this off label approach an acceptable treatment for caries control.<sup>18</sup>

Chlorhexidine 0.12% can reduce MS levels, and combining it with fluoride usage may significantly reduce caries activity.<sup>19,20</sup> Concerns with compliance due to taste, staining and

numerous applications suggest that further studies are needed to develop a better delivery system.<sup>20</sup> Study results on the use of chlorhexidine varnish as a delivery system only found initial effects on reducing MS, thus the caries reducing effect has not been proven.<sup>20</sup> Use of chlorhexidine varnish to block the transmission of MS from mother or caregiver to infant has been suggested.<sup>17</sup> However, while reducing MS, chlorhexidine needs to be carefully considered. It may not be a reasonable preventive procedure in young children, and may be more appropriate for older children or adults.

Dental hygienists can and should be instrumental in reducing ECC. Weintraub and Ismail recommend that dental hygienists should be utilized to educate parents in preventive efforts and provide clinical procedures to reduce ECC.<sup>17,21</sup> Additionally, Weintraub recommends increasing opportunities for dental hygienists in the public health sector to conduct community based interventions. This may stimulate hygienists to become more involved in public health dentistry and place them in a unique position of being the primary preventive provider to reduce incidences of ECC.<sup>21</sup>

Despite this validation of dental hygienists as preventive specialists, a study by Forrest et al revealed that dental hygienists need more education concerning caries etiology, epidemiology and evidence based preventive techniques.<sup>22</sup> The literature rarely discusses dental hygienists' role in caries prevention or, more specifically, ECC.

The purpose of this study was to establish baseline data of dental hygienists' knowledge and understanding of appropriate treatment protocols and to determine influencing factors regarding ECC in the state of Maryland.

## Methodology

This descriptive study utilized a cross-sectional survey design that quantitatively measured practicing Maryland dental hygienists' knowl-

edge, attitudes and practice behaviors regarding prevention of ECC. A random sample of 750 dental hygienists who practiced full or part-time was selected from a list obtained from the Maryland State Board of Dental Examiners. Hygienists not practicing in Maryland and incomplete surveys were excluded. The sampling design was sufficient at providing a generalization of practicing Maryland dental hygienists regarding ECC.

To achieve a sample size that is representative of hygienists actively practicing in Maryland, assuming a sampling error of  $\pm 5\%$ , ( $p < 0.05$ ) with a confidence level of 95%, a final sample size of approximately 345 respondents was projected. Anticipating a 50% response rate, 750 questionnaires were mailed. The mailing included a cover letter, an assurance of confidentiality, a survey instrument of 42 questions and a stamped return envelope. A follow up postcard was mailed to participants approximately 3 weeks later, requesting they respond to the survey.

Indicator measurements were incorporated into the survey instrument. Attributes were collectively exhaustive in nature and mutually exclusive. Responses were categorized as dichotomous or assessed according to a Likert scale. Demographic variables of interest included year of graduation, degree attained, membership in the American Dental Hygienists' Association (ADHA) and employment setting.

Questions on knowledge were adapted from the questionnaire used by Forrest et al.<sup>22</sup> ECC knowledge indicators included ECC etiology, the caries process and bacteria which cause ECC. Other questions were adapted from a study surveying hygienists and nutritionists regarding nutrition and the caries process.<sup>23</sup> Asking respondents about their attitudes about ECC helped gain insight toward knowledge, practice behaviors and possible needed interventions, if gaps existed. Some attitude questions were adapted from a study conducted by Ismail.<sup>17</sup> Practice behavior questions dealt with ECC protocol in

private practice, including questions about nutrition and preventive procedures utilized by hygienists to prevent ECC.

Before the survey was sent, pilot testing was completed to assure reliability and validity. Reliability was measured by adapting information from previous surveys.<sup>17,22,23</sup> Pilot testing was also done to ensure consistency and stability of the instrument. Validity was assessed at face, content, criterion and construct. Face validity assured the questions made sense in terms of the concept.<sup>24</sup> Reviewed and selected indicators were available to ensure content validity. Other studies were used to compare questions assuring criterion validity. Finally, the variables related logically, assuring construct validity. A convenience sample of 15 dental hygienists was selected to pilot test the survey. Twelve surveys were completed and returned. After the surveys were collected, the results were discussed and changes made as necessary. After analyzing the pilot data and making the necessary revisions, a final questionnaire was developed and a random sample was obtained.

The Institutional Review Board at the University of Maryland approved the study prior to the start of the project. Participation in this study was voluntary - a completed and returned survey was considered consent to participate. There were no known risks or benefits to participate in the study. Cover letters included with the survey assured respondents that all information would remain confidential and would be reported in group form only.

The surveys were coded using an identifier number on the survey only. The coded surveys were then analyzed by using Epi-info® software, which tabulated and analyzed the results.<sup>25</sup> Data were in nominal, ordinal and interval form. Frequency testing was used to develop Confidence Interval at 95% and ( $p < 0.05$ ). In order to assure sufficient numbers to produce reliable estimates, variable categories were combined when necessary. Independent variables were age, type of

practice, years practicing since graduation, amount of education, highest degree earned, percentage of children in practice, percentage of Medicaid patients treated, membership with ADHA and years of membership with ADHA.

## Results

The total number of respondents was 308 ( $n=308$ ) for a 41% response rate. Ninety percent of all respondents were from Maryland and practiced in Maryland. Five percent practiced outside of Maryland (not included in the results) and 5% of surveys were returned unanswered. Results revealed that 55% of those surveyed were between 19 and 44 years of age, 45% were 45 and over. Fifty-five percent had graduated less than or equal to 20 years ago from an entry level dental hygiene program, and 45% graduated more than 20 years ago. Fifty-four percent of Maryland hygienists obtained a certificate or Associate's Degree, while 46% earned a Baccalaureate or Master's Degree. Sixty-two percent of respondents practiced less than or equal to 20 years while 38% practiced more than 20 years. Eighty-seven percent practiced in a general practice, 5% practiced in pediatric dentistry and 7% practiced in a format described as "other." Forty-eight percent practiced less than 30 hours per week and 52% practiced greater than or equal to 30 hours per week. While 90% of respondents practiced in a facility with few Medicaid patients (0 to 5%), only 10% practiced in a facility with more than 5% of patients enrolled in Medicaid. Forty-three percent of responding hygienists were members of ADHA. Of those who were members, 74% had been members less than or equal to 5 years and 26% had been members for greater than 5 years.

Overall, results regarding knowledge, attitudes and practice behaviors of Maryland dental hygienists were mixed. Practicing Maryland dental hygienists were correct only 50 to 60% of the time, regardless of the knowledge characteristics mea-

sured. Forty-five percent did not know that caries is an infectious, transmissible disease. Eighty-eight percent believed ECC prevention efforts should start at tooth eruption.

The use of appropriate treatment protocol varied as well. This current study revealed that respondents used oral hygiene instruction (81%), topical fluoride (77%), home applied fluoride (73%), nutritional counseling (65%) and sealants (65%) as preventive behaviors to reduce ECC. Only 25% of those surveyed are using fluoride varnish for caries control.

Figure 1 shows variable labels by characteristic type (knowledge, attitude or practice behavior). While knowledge, attitudes and practice behaviors for ECC are mixed, experience appears to matter. Dental Hygienists that treat more children enrolled in Medicaid made it more likely ( $p < 0.05$ ) for them to reflect current attitudes regarding the timing of the first dental visit and its relationship to ECC.

Table I shows that dental hygienists treating a higher number of children were more likely ( $p < 0.05$ ) to know of the appropriate use of sealants and the use of topical fluoride than hygienists treating fewer children. Dental hygienists with more working hours per week were also more likely ( $p < 0.05$ ) to know of the appropriate use of sealants, nutritional counseling, use of topical fluoride and the importance of a referral to a pediatric dentist than dental hygienists working fewer hours. Dental hygienists who have been ADHA members for a longer period of time were more likely ( $p < 0.05$ ) to know of the appropriate use of topical fluoride or home applied fluoride than hygienists who were members for a shorter amount of time.

## Discussion

Dental hygienists are an important part of dental provider teams dedicated to the prevention of ECC. Hygienists are uniquely positioned to help implement office based and community based prevention programs. Prevention as intervention involving hygienists could involve efforts to re-

duce and eliminate this harmful form of caries. However, before planning or developing such a program, an understanding of the current state of hygienists' involvement and the level of hygienists' knowledge, attitudes and practice behaviors regarding ECC is needed. This study provides baseline information necessary to better understand the current level of dental hygienist knowledge, attitudes and behavior practices concerning ECC in the state of Maryland.

Results indicate that fluoride varnish may be under-utilized to control, treat and prevent ECC. Only 25% of Maryland hygienists are using varnish, which was limited to desensitization. Fluoride varnish is an easy, safe way to apply topical fluoride to teeth. The low usage of varnish for ECC could be attributed to the fact that varnish has not yet been approved by the FDA as an anti-caries prevention agent. However, European countries have been using varnish effectively for over 30 years with positive results.<sup>26</sup> Increased uses of primary care physicians applying fluoride varnish have highlighted the benefits of applying varnish to high risk children. Currently, 34 states provide Medicaid reimbursement for physicians applying varnish to children in need.<sup>27</sup> Maryland dental hygienists may need more information about the off label use of fluoride varnish and its effectiveness on ECC reduction. Similarly, only 20% of Maryland dental hygienists currently use chlorhexidine to prevent ECC. Recent evidence suggests that chlorhexidine can be effective when used by a parent or caregiver with high levels of MS.<sup>20</sup> However, most protocols do not recommend rinses in children less than 6 years of age, as they are likely to swallow large amounts. With the alcohol content of most chlorhexidine rinses, this is an area of concern in child patients. Dental hygienists attitudes about prevention suggested that efforts should be initiated at the first sign of tooth eruption. However, the literature suggests that efforts need to be initiated well before tooth eruption, actually at the prenatal level.<sup>6,8,28,29</sup> In addition,

only 45% of respondents correctly answered that caries is an infectious transmissible disease, suggesting a need to update and educate hygienists on caries, ECC, prevention methodology and protocols.

In this study, the most frequently used preventive approach was oral hygiene instruction, with the lowest being nutritional counseling. Poor dietary habits are one of the major factors involved with ECC and were of least concern by Maryland dental hygienists. Given the critical role of nutrition and ECC occurrence, these results suggest a need to update and educate dental hygienists on the role nutrition plays in ECC to further stress nutrition's critical role.

The results also showed that treating more children enrolled in Medicaid made it more likely that hygienists were current with the timing of the first dental visit and its relationship to ECC. The literature shows that lower SES patients were affected by ECC in greater numbers.<sup>11</sup> These patients typically depend on the Medicaid program to receive dental treatment. Thus, those hygienists who treat higher numbers of Medicaid patients should be more familiar and knowledgeable with the disease, as this research reflected. It should be noted that pediatric dental hygienists typically see these higher number of Medicaid patients, thus dental hygienists working with children in the Medicaid system will have an increased level of knowledge regarding ECC.

Dental hygienists with more experience were also more likely to be aware of ECC appropriate treatment protocols. Dental hygienists working more hours per week were more likely to know of the appropriate use of sealants, nutritional counseling, use of topical fluoride and the importance of a referral to a pediatric dentist. This could be attributed as an outcome of "practicing" and becoming more comfortable and familiar with treatment protocols. Membership in ADHA also proved to be beneficial in an understanding of appropriate protocols for treatment of ECC. Those hygien-

ists who were members for more than 5 years in ADHA were more likely to provide nutritional counseling and home fluoride applications to control ECC. Membership with ADHA may suggest a history of reading the literature available in the association's journal. Given the number of ECC relevant articles presented in the *Journal of Dental Hygiene*,<sup>19,30-33</sup> it is not surprising that ADHA membership would make it more likely that a member would be aware of appropriate ECC treatment protocols.

While providing insight and useful baseline data, limitations to this study must be taken into account. The research was limited to dental hygienists only practicing in Maryland, and the results can therefore be attributed only to the state of Maryland. A further limitation was that the addresses provided by the Maryland State Board of Dental Examiners contained inconsistencies, which may have lowered the response rate and caused some distortions in the results. Speculation exists that response bias may have also had an effect on our results. For example, those hygienists who only treat adults may have felt that the study did not relate to their scope of practice. Also, those that were not familiar with ECC may have declined to participate in the study because their answers may have not been as accurate.

The data indicated that dental hygienists can benefit from continuing education courses regarding caries and specifically ECC. Dental hygienists in Maryland will encounter ECC in practice and should be current on the latest techniques and information to enhance their preventive role. Overall, 95% of Maryland hygienists agree and would like to take a course regarding ECC.

While this study provided important results and insight into dental hygienists' knowledge, attitudes and practice behaviors regarding ECC, results of this study also reveal a need for additional education of Maryland dental hygienists about ECC and possibly curriculum changes to integrate more knowledge regarding ECC while in school. Thus, additional re-

search is needed to determine how to increase the knowledge of dental hygienists in the area of ECC and thus impact positive attitudes and practice behaviors.

### Conclusion

Dental hygienists are qualified health care professionals who can educate parents regarding ECC and be an active part of the team dedicated to the prevention of ECC. This study revealed that there is a need to decrease gaps in knowledge, attitudes and practice behaviors regarding ECC by dental hygienists in the state of Maryland. This research suggests a need for additional information about ECC through dental hygiene curricula and/or continuing education courses. Since 95% of surveyed hygienists indicated an interest in taking a continuing edu-

cation course about ECC, the results of this study suggest that additional education in this area would be well received.

### Acknowledgement

Ms. Manski would like to thank my thesis committee, Dr. M. Elaine Parker, RDH, PhD, Dr. Harold Goodman, DDS, MPH, Dr. Mark Macek, DDS, MPH, Dr. PH and Ms. Sheryl Syme, RDH, MS for all their help and guidance in this endeavor. Further thanks to Ms. Jacquelyn Fried, RDH, MS for her further guidance.

*Marion Manski, RDH, MS, is the Director of Admissions and Recruitment and Dental School Assistant Professor in the Department of Health Promotion and Policy - Dental Hygiene Division of the University of Maryland Dental School.*

Figure 1. Variable Label By Characteristic Type

Variable Characteristic Label	Variable Characteristic Type
Knows that ECC is a transmissible disease	Knowledge
Know that ECC is an infectious disease	Knowledge
Prevention efforts should start at eruption	Attitude
Oral hygiene instruction as treatment	Practice Behavior
Nutritional counseling as treatment	Practice Behavior
Fluoride varnish as treatment	Practice Behavior
Home applied Fluorides as treatment	Practice Behavior
When to refer to a pediatric dentist	Attitude
Sealants as treatment	Practice Behavior
Timing of the first dental visit	Attitude

Table I. Current of

	Total Sample	P
Sample characteristic	Sample Size (N)	P
Total	308	100%
Children in Practice		
0-24	160	52%
25-100	148	48%
Hours Practice		
Less than 30	148	48%
30 and above	60	19%
Years Member		
5 or less	228	74%
Greater than 5	80	26%

a Sample size and sample percentage  
b Treatment protocol significance

### References

- Dye BA, Tan S, Smith V, et al. Trends in oral health status: United States, 1988-1994 and 1999-2004. *Vital Health Stat* 11. 2007;248:1-92.
- U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health. 2000.
- Krust-Bray K, Banson BG, Williams K. Early Childhood Caries in an Urban Health Department: An Exploratory Study. *J Dent Hyg*. 2003;77(4):225-232.
- Douglass JM, Tinanoff N, Tang JMW, Altman DS. Dental caries patterns and oral health behaviors in Arizona infants and toddlers. *Community Dent Oral Epidemiol*. 2001;29(1):14-22.
- Selwitz RH, Ismail AI, Pitts NB. Dental caries. *Lancet*. 2007;369(9555):51-59.
- Yost J, Li Y. Promoting Oral Health from Birth Through Childhood Prevention of Early Childhood Caries. *MCN Am J Matern Child Nurs*. 2008;33(1):17-23.
- American Academy of Pediatric Dentistry. Policy on Early Childhood Caries (ECC): Classifications, Consequences, and Preventive Strategies. *Pediatr Dent*. 2007;29(7):39-41.
- Wyne AH. Early childhood caries: nomenclature and case definition. *Community Dent Oral Epidemiol*. 1999;27:313-315.
- Weinstein P, Harrison R, Benton T. Motivating parents to prevent caries in their young children. *J Am Dent Assoc*. 2004;135(6):731-738.
- Weintraub JA. Prevention of early childhood caries: a public health perspective. *Community Dent Oral Epidemiol*. 1998;26(1 Supp):62-66.
- Beaulieu E, Dufour LA, Beudet R. Better Oral Health for Infants and Toddlers: A Community Based Program. *J Dent Hyg*. 2000;74(2):131-134.
- Vachirarojpisit T, Shinada K, Kawaguchi Y, Laungwechakan P, Somkote T, Detsomboonrat P. Early childhood caries in children aged 6-19 months. *Community Dent Oral Epidemiol*. 2004;32(2):133-142.
- Guideline on Infant oral health care. American Academy of Pediatric Dentistry [Internet]. 2009 [cited 2010, September]. Available from: [http://www.specializedcare.com/pdfs/G\\_InfantOralHealthCare.pdf](http://www.specializedcare.com/pdfs/G_InfantOralHealthCare.pdf)
- Policy Statement: oral Health Risk Assessment Timing and Establishment of the Dental Home. American Academy of Pediatrics [Internet]. 2003 [cited 2008 March 21]. Available from: <http://aappolicy.aappublications>.

# Fluoride treatment protocol for ECC<sup>b</sup>

Percentage	Sealant		Nutritional counseling		Topical Fluoride		Referral to a Pedodontist		Home applied fluorides	
	Sample Size (N)	Percentage	Sample Size (N)	Percentage	Sample Size (N)	Percentage	Sample Size (N)	Percentage	Sample Size (N)	Percentage
100	201	65.3	200	64.9	236	76.6	141	45.8	225	73.0
80.0	87	54.4	93	58.1	106	66.3	70	43.8	100	62.5
83.1	114	77.0	107	72.3	130	87.8	71	48.0	125	84.5
83.1	84	56.8	82	55.4	100	67.6	51	34.5	98	66.2
82.0	117	73.1	118	73.8	136	85.0	90	56.3	127	79.4
84.0	141	61.8	137	60.1	164	71.9	99	43.4	156	68.4
86.0	60	75.0	63	78.8	72	90.0	42	52.5	69	86.3

Percentage for each characteristic shown as shaded area

Significance at the .05 level shown as inverted area (black background white numbers)

- <http://www.pediatrics.org/cgi/content/full/pediatrics;111/5/1113>.
- Quiñonez RB, Stearns SC, Talekar BS, Rozier RG, Downs SM. Simulating Cost-effectiveness of Fluoride Varnish During Well-Child Visits for Medicaid-Enrolled Children. *Arch Pediatr Adolesc Med.* 2006;160(2):164-170.
  - Weintraub JA, Ramos-Gomez F, Jue B, et al. Fluoride Varnish Efficacy in Preventing Early Childhood Caries. *J Dent Res.* 2006;85(2):172-176.
  - Ismail AI. Prevention of early childhood caries. *Community Dent Oral Epidemiol.* 1998;26(Suppl 1):49-61.
  - US Department of Health and Human Services. Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States. Center for Disease Control [Internet]. [cited 2008, March 25]. Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5014a1.htm>
  - Milgrom P, Rothen M, Spadafora A, Skaret E. A case report: arresting dental caries. *J Dent Hyg.* 2001;75(3):241-243.
  - Featherstone JD. Delivery Challenges for Fluoride, Chlorhexidine and Xylitol. *BMC Oral Health.* 2006;6(Suppl 1):S8.
  - Weintraub JA. Prevention of early childhood caries: a public health perspective. *Community Dent Oral Epidemiol.* 1998;26(Suppl 1):62-66.
  - Forrest JL, Horowitz AM, Shmueli Y. Caries Preventive Knowledge and Practices among Dental Hygienists. *J Dent Hyg.* 2000;74(3):183-195.
  - Faine MP, Oberg D. Survey of dental nutrition knowledge of WIC nutritionists and public health dental hygienists. *J Am Diet Assoc.* 1995;95(2):190-194.
  - Singleton RA, Straits BC. Approaches to Social Research. 3rd ed. New York (NY): Oxford University Press; 1999. 239-277 p.
  - US Department of Health and Human Services. What is Epi Info? Centers for Disease Control [Internet]. [cited 2010, September]. Available from: <http://www.cdc.gov/epiinfo>
  - Holm AK. Effect of a fluoride varnish (Duraphat) in preschool children. *Community Dent Oral Epidemiol.* 1979;7(5):241-245.
  - Cantrell C. Engaging Primary Care Medical Providers in Oral Health. National Academy for State Health Policy [Internet]. September, 2009 [cited 2010, January 5]. Available from: <http://www.nashp.org/sites/default/files/EngagingPrimaryCareMedicalProvidersCOH.pdf>.
  - Milgrom P. Response to Reisine & Douglass: Psychosocial and behavioral issues in early childhood caries. *Community Dent Oral Epidemiol.* 1998;26(1 Suppl):45-48.
  - Karn TA, O'Sullivan DM, Tinanoff N. Colonization of Mutans Streptococci in 8- to-15-month-old children. *J Public Health Dent.* 1998;58(3):248-249.
  - Barber LR, Wilkins EM. Evidence-based prevention, management, and monitoring of dental caries. *J Dent Hyg.* 2002;76(4):270-275.
  - Warren DP, Infante NB, Rice HC, Turner SD, Chan JT. Effect of topical fluoride on retention of pit and fissure sealants. *J Dent Hyg.* 2001;75(1):21-24.
  - Boyd LD, Dwyer JD. Guidelines for nutrition screening, assessment, and intervention in the dental office. *J Dent Hyg.* 1998;72(4):31-43.
  - Hornick B. Diet and nutrition implications for oral health. *J Dent Hyg.* 2002;76(1):67-78; quiz 79-81.

# DENTSPLY Posters

Disclaimer: The DENTSPLY Posters and Abstracts were not peer-reviewed prior to publication in the *Journal of Dental Hygiene*.

## Dental Hygiene Student Knowledge of Genetics in Dentistry: Baseline Measures

\* Amy Coplen, RDH, BSDH, MS  
University of Michigan, School of Dentistry

**Problem:** Current information about dental hygiene students' knowledge of genetics in dentistry is unavailable. This study provides a baseline assessment of dental hygiene students' knowledge prior to implementation of formal instruction related to genetics and oral health.

**Methods:** An instrument to test students' knowledge of genetics was developed in consultation with a geneticist and pilot tested with dental students. The instrument included case scenarios with genetic components and definitions of genetic terms. Data were collected from entering dental hygiene (DH) students on the first day of class and senior DH students in their final semester. Responses were entered into SPSS 16.0 and comparisons were made between the two levels of students using independent sample T-tests.

**Results:** Senior DH students averaged a higher total score (54%) than entering DH students (48%). This difference was not statistically significant. Entering students did slightly better than seniors on the definition section of the exam with scores of 45% and 42% respectively. Seniors did significantly better than entering students on the case scenarios section of the test ( $p=.013$ ) with scores of 63% and 51% respectively. Senior students scored significantly higher than entering students on case scenarios relating to periodontal disease, ectodermal dysplasia and Down syndrome.

**Conclusion:** Both entering and graduating dental hygiene students scored low, less than a 55% on an exam, in a program with no formalized genetics content. A genetic curriculum using Web-based case simulations will be implemented in the fall of 2008 at the University of Michigan with dental hygiene students. Ongoing assessment will be conducted.

## Bactericidal Effects of Low Temperature Atmospheric Pressure Plasma on Porphyromonas Gingivalis

\* Arwa Mahasneh, BS, MSDH  
Old Dominion University

**Purpose:** The biomedical application of low temperature atmospheric pressure plasma (LTAPP) is a collaborative interest for engineering, medical, dental and biological researchers. This laboratory study tested whether LTAPP can limit growth of Porphyromonas gingivalis, a periodontal pathogen strongly associated with periodontal disease, disease progression, and refractory periodontitis.

**Methods:** After extensive pilot trials, the study consisted of

24 agar plate samples of P. gingivalis- 20 samples were exposed to LTAPP at 5, 7, 9 and 10 minutes and 4 control samples were exposed to helium gas only. Immediately after exposures, the samples were incubated anaerobically for 72 hour at 37°C. After 72 hours, zones of inhibition were measured.

**Results:** After 5, 7, 9, and 11 minutes of exposure times, results reveal a statistically significant difference in the bactericidal effect of the LTAPP on P. gingivalis compared to control bacteria not exposed, as measured by zone of inhibition (cm) ( $p<0.0001$ ). Differences in the bactericidal effects were significant for each pair of consecutive time points: 5 minutes verses 7 minutes, 7 minutes verses 9 minutes, and 9 minutes verses 11 minutes ( $p=0.0360$ ,  $p=0.0009$ , and  $p<0.0001$ , respectively).

**Conclusions:** LTAPP has a significant dose related bactericidal effect on P. gingivalis, as measured by zone of inhibition [here]

## Professional Association Membership: Factors Affecting the Dental Hygienist's Decision to Join and the Value of Membership Benefits

\* Camile M. Luke, RDH, BSDH  
Eastern Washington University

Dental hygienists throughout the nation are represented by professional associations that support and promote their interest. Benefits provided by membership within a professional association were assessed to determine if a direct relationship existed between what is deemed valuable to members and if non members also placed value on similar items. The social exchange theory was the theoretical framework used to understand value placed on membership within a professional association.

The purpose was to identifying if the value placed on membership benefits directly relate to the decision to join a professional association. This study utilized a Professional Membership Questionnaire (PAMQ) which was used for similar questions in the nursing profession. Using a Likert-type scale, it assigned value to 29 different membership benefits related to affiliation with a professional association, as well as collected demographic information. Open ended questions were included to assess benefits with highest value, past membership status and reasons for never joining or not renewing membership. Participants were selected from a list of licensed dental hygienists from four different states, Nebraska, Texas, Vermont, and Washington, with a sample size totaling 415. PAMQ surveys were mailed to random addresses on file with each state licensing body.

The results have not yet been analyzed. The statistical analysis will be completed using chi squared tests to determine differences between members and nonmembers in the value placed on the 29 benefits related to professional association membership. This will identify the necessary p-value to determine a statistically significant difference between the two groups.

## Analysis of Periodontal Maintenance Care: An Exploratory Study

\* Connie L. Jamison, RDH, BS

University of Missouri-Kansas City

**Abstract:** Periodontal Maintenance (PM) is comprised of the preventive, diagnostic, and therapeutic procedures needed for sustaining periodontal health. For PM to be effective, sufficient time must be allotted in accordance with the needs of the individual patient.

The purpose of this study was to assess the relative contribution of patient-level factors such as, oral health status, past compliance with maintenance, and medical condition/history, and time required for effective PM. 100 consecutive patients receiving PM were observed at a single time-point and components of PM timed in minutes/seconds. Descriptive statistics showed the average time for each component (in minutes) was: greeting 2:57, medical history 3:50, radiology 6:04, oral history 3:23, periodontal examination 14:23, assessments 3:22, treatment phase 29:34, treatment plan 5:25, dismissal time 6:21, OSHA 8:00 and total time 1 hour, 24 minutes. Bivariate analyses indicate that bleeding on probing, depth of pockets, gender, number of teeth, and oral hygiene are predictors that affect PM time.

Results from multiple linear regression showed BOP and subgingival calculus are significant predictors of total treatment ( $p < .05$ ,  $R^2 = .28$ ). The current standard of care for a PM appointment of 50–60 minutes appears to be insufficient with the average 1 hour, 24 minutes to achieve the goals of PM. BOP and subgingival calculus appear to be the greatest predictors of time when other variables are in the model. This data may influence the professional's view of the standard of care and be useful in planning appropriate time allotment for PM and advancements in treatment care management.

## Training the Trainer: Disabilities and Dental Hygiene

\* Elmer E. Gonzalez, RDH, BS, BA

University of New Mexico, Division of Dental Hygiene

This study was intended to measure knowledge change of direct care staff upon administration of an oral health education completed by lecture materials and/or hands on training. The study was an experimental design which included 30 participants from a local agency dedicated to serve people with disabilities. The sample consisted originally of two groups of 15 participants each. However, the actual number of subjects was 14 in the experimental group and 10 in the control group. Each group was randomly assigned to either a control or an experimental group. The experimental group received a lecture and hands on training for a total of one hour and forty five minutes. The control group received a discussion. Both the experimental and control groups received a pre- test and a post test.

Considering all subjects together as a single group,  $n=24$ , the two sample t-test gave an estimated score difference of 0.05 which was significantly larger than zero ( $p$ -value=0.005),  $t=2.168$ ,  $df=23$ ,  $p$ -value= 0.005. Overall learning increased between tests. Considering the two groups independently, using a paired t-test to examine the data, the experimental group,  $n=14$  had an estimated score difference of 0.0607 ( $p$ -value=0.01),  $t=$

2.645,  $df=13$ ,  $p$ -value= 0.01, which was a significant improvement. The control group  $n=10$ , had an estimated score difference of 0.035 ( $p$ -value=0.14),  $t=1.172$ ,  $df=9$ ,  $p$ -value= 0.135, which was not a significant improvement.

This study is beneficial in showing the influence of oral hygiene training for direct care staff who work with people with disabilities.

## Current Status of Degree Completion Programs in Dental Hygiene Education

\* Karen M. Portillo, RDH, BSDH

Idaho State University/MSDH Program

**Purpose:** Dental hygiene baccalaureate degree completion programs are essential stepping stones between associate degree entry-level programs and graduate education. The purpose of this descriptive study was to assess student learning outcomes, learning experiences, assessment methods, and baccalaureate partnerships for degree completion programs, since a minimal amount of literature currently exists.

**Methods:** An online survey was used to collect data from 42 program directors whose degree completion programs met the inclusion criteria. Reliability and validity of the self-designed survey instrument was established by a panel of experts and pilot tested with three program directors whose programs did not meet the inclusion criteria. Program directors were either contacted to introduce the study protocol. The participants were provided a direct link to the survey and three e-mail messages were sent as reminders.

**Results:** A 62% ( $n=26$ ) response rate was obtained. Results indicated that student learning outcomes were articulated for professional development, ethics, communication, critical thinking, evidence-based practice, career roles, leadership, community oral health, health promotion/disease prevention, dental hygiene clinical care, interprofessional collaboration, dental hygiene education, and preparation for graduate studies. Learning experiences included dental hygiene courses such as research (88.5%), educational methodology (65.4%), and practicum, internship, or externship (65.4%). Assessment methods included grade point averages (69.2%), capstone projects (65.4%), alumni surveys (65.4%), graduate exit interviews (50%), and portfolios (34.6%). Baccalaureate partnerships reported were articulation (87.5%), community college baccalaureate (8.3%), and university extension (4.2%) models.

**Conclusions:** Degree completion programs increase educational levels of associate degree graduates by providing opportunities for professional and career development.

## Incorporating Oral-Systemic Evidence into Patient Care: Practice Behaviors and Barriers of North Carolina Dental Hygienists

\* Kathryn P. Bell, RDH, BSDH

University of North Carolina

NDHRA focus area: Clinical Dental Hygiene Care

**Problem:** Current research has reported associations between periodontal and systemic health, however there are little

data regarding how dental hygienists (DH) are incorporating this evidence into practice.

The purpose of this study was to determine what practice behaviors are prevalent among North Carolina (NC) DH regarding the incorporation of oral-systemic evidence (OSE) into practice as well as perceived barriers to implementation.

**Hypothesis:** NC DH are not incorporating OSE into practice. **Methods:** A questionnaire was developed, pilot tested, revised and mailed to 1,665 licensed DH in NC. The response rate was 62% with 52% (N=859) of respondents meeting inclusion criteria. Survey data were analyzed using descriptive statistics and Chi-square analysis.

**Results:** Respondents were female (99%), with a two-year degree (84%). While a minority of DH (20%) reported measuring blood pressure (BP) routinely on all patients, a majority (62%) measure BP in select patients. Eighty-nine percent perform oral cancer screenings. Eight percent record blood sugar levels, but only 3% record HbA1c values. Fifty percent of DH are extremely likely to refer patients to a medical provider for follow up assessments. Conditions DH are likely to discuss with patients include tobacco use (89%), pregnancy (84%), and genetics (79%). Significant barriers to implementing OSE include lack of time (52%), concern over legal risks (44%), and lack of education (27%).

**Conclusions:** NC DH are implementing some aspects of OSE into practice but could take a more active role if they had more allotted time, education and training.

### The Use of Guided Imagery in the Instruction of Periodontal Instrumentation Skills: A Pilot Study

\* Kimberly S. Johnson, RDH, BS  
University of Minnesota

**Purpose:** Guided imagery (GI) is a process that allows a person to use their own imagination to connect their body and mind to achieve a desirable outcome such as the learning of a complex, perceptual-motor skill. Preparing students to perform clinical skills at a level that indicates achievement of accepted evaluation criteria may be facilitated by GI. The purpose of this study was to incorporate the use of GI into preclinical periodontal instrumentation training and evaluation by comparing a group of students who received GI in their instruction to a group who did not.

**Objective:** Compare the clinical evaluation of instrumentation skills for students who underwent GI vs. those who did not.

**Methods:** 21 students in the preclinical dental hygiene course were randomly assigned to two groups: GI or no GI. Pre/post test Vividness of Visual Imagery Questionnaire (VVIQ) was administered.

**Results:** There was no evidence that change in mean VVIQ scores were different between the groups ( $p=0.616$ ). There was no evidence that mean instrument scores were different between the groups ( $p=0.113 - 0.847$ ). A random intercept model was used to compare total scores between instruments and groups. The two groups were not different ( $p=0.204$ ), but statistically significant differences ( $p<0.0001$ ) in total scores were found.

**Conclusions:** Although the results of this study did not support the hypothesis that there would be improved performance of instrumentation skills for subjects who received GI vs. those subjects who did not, the follow-up questionnaire did indicate that the subjects who received GI were more relaxed.

### Looking Ahead: Genes Linked to Periodontal Health and Tissue Regeneration

\* Lay Soon, RDH, BA  
University of Washington

NDHRA focus area: This research relates to the NDHRA focus area about how dental hygienists involve emerging science in diagnostic aspects of the dental hygiene process of care.

**Problem:** Genetic susceptibility is among the key risk factors for periodontal disease, with an estimated 30% of the population genetically susceptible. Diagnosis of periodontal risk genes may guide preventive hygiene measures and help at-risk individuals keep their teeth.

The purpose of this study was to investigate factors influencing periodontal development, including ankylosis protein (ANK) and ectonucleotide pyrophosphatase/phosphodiesterase 1 (ENPP1). Mouse models where either ANK or ENPP1 function was genetically knocked out (KO) were compared/contrasted.

**Hypothesis:** Based on similar functions of ANK and ENPP1, we hypothesized that ENPP1 KO mice would exhibit thick cementum comparable to previous data from ANK KO teeth.

**Methods:** Coronal sections of mouse first mandibular molars were examined at 26 days old, when tooth root was complete. Histomorphometry was used to measure cervical cementum, periodontal ligament, and bone in  $n=3$  mice for KO and controls. ANOVA was used for intergroup statistical analysis.

**Results:** ANK and ENPP1 KO models exhibited cementum up to 12-fold thicker than controls, with ANK KO cementum thicker than ENPP1 KO. Periodontal ligament width was maintained in both KO mouse models despite cementum expansion.

**Conclusions:** Results supported our hypothesis that ENPP1 KO cementum would resemble ANK KO hypercementosis. Both factors are implicated to be critical in periodontal development/maintenance. Because their loss promotes cementogenesis, these factors may be good targets for therapies to promote cementum regeneration. (248)

### The Effects of Social Promotion on the Validity and Predictability of Dental Hygiene Selection Criteria

\* Marilee S. Mcgaughey, RDH, BSDH  
University of Tennessee Health Science Center

Dental hygiene education is rich in transformative, experiential learning that is integrated with classroom learning, in essence, the non-cognitive combined with the cognitive learning in order to transform the knowledge base into the clinical application. The increasing demand of knowledge base and clinical skills required of dental hygiene students creates a dilemma not only for student success but also for dental hygiene educators when students enter the program with less than the required aptitude and skills. If students are ill-prepared, it becomes a

daunting task to reach a level of competency for both the student and the educator. What is the cause of this discrepancy in the level of readiness for academic success? Traditionally, dental hygiene programs have relied on GPA and standardized test scores as the main selection criteria in their admissions process. Although these means may provide a picture of the applicant's cognitive abilities, they do nothing towards providing a picture of the non-cognitive abilities and the students' ultimate ability to succeed. Social promotion and its associated grade inflation may be a critical factor in why grade point average (GPA) is not an accurate indicator of a student's academic abilities. Realization of this discrepancy and the need for a solution to better predict student success was the impetus for this research project. The purpose of this study was to investigate the effects of social promotion on the validity and predictability of dental hygiene admissions selection criteria as it relates to student success in the program.

### **The Ethics of Live Patient Use in Dental Hygiene Clinical Licensure Examinations: A National Survey of Recently Licensed Dental Hygienists**

*\* Marlaina J. Reich, RDH, BAS*

*Baylor College of Dentistry Caruth School of Dental Hygiene*

A national survey was conducted that explored the ethical issues involved with using live patients for dental hygiene clinical licensure examinations. The survey collected data regarding demographics, additional costs to candidates beyond the examination fees, delays in dental hygiene treatment, unethical candidate and/or patient behaviors and the provision of appropriate follow-up care. Survey questions addressed the ethical practices of respondents and included attitudinal questions which mirrored the same concepts. Respondents were also asked if they felt their clinical licensure examination was an accurate reflection of their clinical skills. The survey was mailed to 500 registered dental hygienists, from two states in each of the five licensure examination regions, with a response rate of 40.6% (n=203). The data was analyzed using descriptive statistics.

Results indicated that the majority of respondents spent additional money on examination related expenses (70.3%). Approximately 61% of respondents reported paying their patient, although only half felt that it was acceptable to do so. Over half of the respondents (53.1%) believed that it was appropriate to delay treatment in order to have a patient sit for the ex-

amination; however, only 16.4% reported delaying treatment. Informed consent was obtained by 94.9% of respondents. The majority of respondents (86.6%) made arrangements for dental hygiene follow-up care. When asked if they felt the examination was an accurate assessment of their clinical skills, 78.7% of respondents agreed.

The results indicated that the majority of respondents upheld the ethical standards of the dental hygiene profession and complied with examination rules.

### **Clinical Faculty Attitudes and Perceived Value of Magnification in Dental Hygiene Education**

*\* Sandra Stramoski, RDH, BS*

*University of Bridgeport Fones School of Dental Hygiene*

**Purpose:** The purpose of this study was to appraise the perceived benefits of magnification loupes by clinical dental hygiene faculty, to assess the degree to which loupes were being utilized in educational settings, which factors were a deterrent to using magnification loupes in teaching and clinical practice and whether faculty were willing to endorse magnification loupes with students.

**Methods:** A 40-question electronic survey was completed by 249 clinical instructors from 37 states. This instrument assessed perceived advantages and disadvantages of loupes, the level of agreement with value statements regarding loupes, and reasons for avoidance.

**Results:** Chi-square analyses were used to compare user (n = 158) to non-user (n = 91) groups and found very highly significant differences (p = <0.001) for the advantage factors of "enhanced vision," "radiographic interpretation," and "soft tissue evaluation," and significant differences (p = <0.05) for "ergonomics/posture" and "caries detection," with magnification users rating the advantages more favorably. Significant differences were generally not found in assessment of disadvantages. Mean scores for agreement by users with value statements regarding loupes were high (>4.0 out of 5.0), and both groups agreed loupes should be at least optional in dental hygiene school. Half of the non-user group stated they did not use loupes because they were "too expensive."

**Conclusion:** This study shows support for magnification loupes to be at least optional in the dental hygiene curriculum. Although more than one-third of respondents did not personally use loupes, most appreciate that magnification offers significant benefits to dental hygiene clinicians.

# CLL Poster Sessions

## **Evaluation of the Effectiveness of Tutoring in a Pre-Clinical Laboratory Course**

\*Holly C. Rice, RDH, MEd and Alan E. Levine, PhD, MEd  
*The University of Texas Dental Branch at Houston*

The purpose of the study is to evaluate the effectiveness of tutoring in a first year dental hygiene pre-clinical laboratory course. Tutoring was offered to students enrolled in the course. Dental hygiene students are expected to meet rigorous clinical performance criteria and developing these clinical skills is a critical component of dental hygiene education.

The tutoring program was evaluated using a nineteen question survey instrument which students anonymously filled out on Blackboard. Approval for the study was obtained from the university's Human Subjects Institutional Review Board. The study population consisted of the classes of 2007-2010 with a total of one hundred and forty-eight students.

Approximately two-thirds (sixty) of the students responding to the survey took part in tutoring sessions. The majority of the tutoring was conducted by faculty with some sessions utilizing peer tutors.

Results of the survey found that a majority of the students participating in tutoring felt that the extra practice and the desire to feel more confident with the instruments were the major reasons for attending tutoring. The survey results found that a majority of the students felt that they were able to adapt the instruments to the typodont better after participating in tutoring. Ninety percent of the students responding to the survey felt that the tutoring helped them feel better prepared for clinic. Greater than sixty percent responding felt that tutoring was more effective than the actual laboratory session and that the peer tutor was as beneficial as a faculty tutor.

## **Calibration of Dental Hygiene Faculty Prior to Instrumentation Evaluations**

\*Beverly A. McClure, RDH, BS  
*Ohio State University*

The purpose of this new program was to calibrate all faculty members to help provide consistent and fair evaluations of instrumentation competencies for beginning dental hygiene (DH) students. A new schedule was being introduced so that beginning DH students would complete 4 periodontal instrumentation competencies prior to the new quarter clinical rotations. These competencies would be evaluated in one clinical session on a classmate. This would require the majority of faculty to evaluate the competencies.

Calibration of faculty is a continual challenge of dental hygiene educators. Students sometimes get confused when one faculty member gives low marks on a case and the student perceives (sometimes correctly) that another faculty member had given them high marks on a similar case. In order to best evaluate and fairly grade the competencies, the pre-clinic course directors were asked to review instrumentation techniques and

probably more importantly conduct an interactive session discussing what would constitute a point deduction on each category with the faculty.

This calibration session took place at a required faculty meeting before the school year started. Faculty participation was energetic and guidelines were established to help grade consistently. A 6-question Likert survey was given to full and part time DH faculty (N=15) following the competency evaluations. One hundred percent of the faculty either strongly agreed (SA), agreed (A) or slightly agreed (SL A) that the suggestions on how to grade specific items and the review of instrumentation techniques were helpful. As a result of the review 100% of the faculty either (SA), (A) or (SL A) that faculty are grading with more consistency.

One-hundred percent of the faculty (SA) or (A) felt better prepared to evaluate competency exams because of the review session and they would like to have other faculty reviews concerning other competency exams. The faculty members were asked which competencies should be reviewed and the outcome in order of the top three were amalgam finishing and polishing, periodontal assessment and the ultrasonic scaler. Review sessions appear to be helpful to faculty in evaluating competencies. The faculty members feel that calibration has improved. At the request of faculty, more calibration sessions will be held.

## **Broadening Dental Hygiene Education Through Interprofessional Collaboration**

\*Susan Jenkins, RDH, MS; Lois Angelo, MSN, APRN; Marie Dacey, EdD; Timothy J. Maher, PhD; Ana Maldonado PA-C/MPH; Stephanie Rhymer, BS, RT(N), CNMT; and Rick L. Shifley, PhD  
*Massachusetts College of Pharmacy & Health Sciences*

Literature indicates that most college level interprofessional education/initiatives do not include dental professionals. In 2008, The Massachusetts College of Pharmacy & Health Sciences, in an effort to gain a position as a leader in interprofessional collaboration, implemented the Schwartz Center Educational Rounds Difficult Conversations Committee, with the goal of improving communication between health care professionals and patients. The committee includes faculty members from dental hygiene, pharmacy, physician assistant studies, nursing, radiological sciences, health psychology, and health science/premed studies.

Difficult Conversations is a forum where students, from all disciplines, are given an opportunity to share their positive and negative experiences associated with a chosen topic. An email was sent to the entire student body inviting them to participate. Interested students responded with their personal experiences. Five students respond, including one dental hygiene student, who, after review by the committee, was chosen as a panel member. All members of the college community were invited to attend. The forum was presented during the college's

mid-day activity period, with lunch provided by the Schwartz Center, to everyone who RSVP'd. Each student had 5-minutes to present their story, followed by a question and answer period, all guided by a facilitator.

Attendees are asked to complete a four-question, five-point Likert Scale evaluation asking the following: The case presentations were thought provoking. I gained perspectives that will help me care for my patients. I gained perspective that will help me work more effectively with colleagues. The discussion facilitated reflection about my current or future clinical experience. Program evaluations have been consistently high: 91.6% "case presentations were thought provoking"; 71.2% "gained perspective that will help me work more effectively with my patients/colleagues; 90.1% "the discussion facilitated reflection about my current or future clinical experiences". The outcomes demonstrate that there is potential to improve communication between health care professionals and patients through this mechanism.

### **Knowledge, Opinions and Practice Behaviors of North Carolina Endocrinologists and Internists Regarding Periodontal Disease and Diabetes**

*\*Jonathan B. Owens, RDH, BS; Janet H. Southerland, RDH, DDS, PhD; John B. Buse, MD, PhD; Robert M. Malone, PharmD; and Rebecca S. Wilder, RDH, MS University of North Carolina School of Dentistry*

**Objective:** This study accessed the knowledge, opinions, and practice behaviors of North Carolina (NC) endocrinologists and internists regarding periodontal disease (PD) and the impact on diabetes.

**Methods:** A questionnaire was developed, IRB approved, pilot tested, revised and mailed to 1,000 internists and 140 endocrinologists in NC. After two mailings the response rate was 28% (N=317). A third mailing was conducted in January 2010 and will be analyzed in March. Data were analyzed using SAS version 9.1, utilizing descriptive statistical methods.

**Results:** Respondents were 66% male. Only 21% agreed they were knowledgeable regarding the studies linking periodontal disease and diabetes. When asked how often an oral examination was performed, 31% rarely performed an oral examination, 27% only when the patient mentioned a problem and 24% at every visit. When asked if a routine oral examination was not provided, 35% indicated it is the responsibility of dental professionals and 34% are not sure what type of oral examination to perform. Seventy-one percent refer patients when they think something needs further examination and 64% refer if a patient expresses concern. Most (95%) agree that good periodontal health is important to overall health and 81% think physicians should be taught to screen for periodontal disease. Eighty-nine percent support collaboration with dental professionals.

**Conclusions:** NC endocrinologists and internists do not feel knowledgeable about PD research as it relates to diabetes but the majority indicated that collaboration with oral health professionals is important. More research needs to be conducted on how to establish collaboration between physicians and oral health professionals.

**Acknowledgement:** This project was funded by an unrestricted research grant from Colgate Oral Pharmaceuticals.

### **Examining Peer Assessment in a Didactic Team-Based Learning Course**

*Melanie L. Simmer-Beck, RDH, MS; Nancy T. Keselyak, RDH, MA; and Cynthia Gadbury-Amyot, RDH, EdD University of Missouri-Kansas City*

**Purpose:** This project examined the effectiveness of a peer assessment tool at holding individuals accountable for their contributions to group assignments.

**Statement of the Problem and Significance:** As dental educators incorporate more interactive and group learning methodologies into the curricula, individual accountability must be factored into course grades. To ensure students have an opportunity to reward peers who contribute most to group assignments and help individuals recognize the need to be individually accountable to their team, peer assessments are considered essential components of team-based learning.

**Methodology:** Data from the dental hygiene classes of 2009 and 2010 were examined at the completion of an introduction dental hygiene course (n=59). Students were allowed 10 points per team member, excluding themselves, to distribute to among teammates. Students were instructed to complete a peer assessment for each student in their team by assigning at least one student 11 points or higher and one student was 9 points or lower with a rationale for the highest and lowest ratings. Scores for each student were averaged. Variability among teams was examined by observing student scores by team. Individual scores of 11 or higher and scores 9 or lower were selected for review of the narrative feedback using the Constant Comparative method to identify common themes.

**Results:** Variability among individual scores was noted in seven of the ten teams with scores ranging from 12 to 7.4. Two themes emerged from the data as determinants for both high and low scores; Social Interaction and Work Ethic. The peer assessment method used in this project demonstrated the ability to differentiate between groups where individual students contributed equally and groups where individual students contributed at different levels.

**Conclusion:** The peer assessment method described in this study signifies the potential of a peer assessment method, such as the one used, to improve team based learning.

### **Assessing Professional Education in the Care of Patients with Neurodevelopmental Disorders and Intellectual Disabilities in U.S. Dental Hygiene Programs**

*\*Christine A. Dominick, RDH, MEd; Kamila Kazmierczak; and Mary E. Foley, RDH, MPH Massachusetts College of Pharmacy and Forsyth School of Dental Hygiene*

**Objectives:** The aim of this study was to: 1) raise awareness among dental hygiene program directors about the need for specialized curricula related to the care and treatment of special

needs patients; 2) assess the extent to which CODA accredited dental hygiene programs incorporate specialized curricula related to the assessment and treatment of patients with neurodevelopmental and intellectual disabilities.

**Methods:** An 11-item questionnaire was distributed via a web-based survey tool (Zoomerang) to 231 US dental hygiene program directors. Data gathered included the number of instructional hours, types of instruction, professional experiences and faculty participation related to the education of students on the assessment, care and treatment of special needs patients. The survey questionnaire was e-mailed in May 2008 with two follow up requests 60 and 90 days later. Descriptive statistics were noted and multiple regression analysis was conducted using SPSS software.

**Results:** Of the 231 surveys, 58% (N=134) were returned. Analysis revealed that 98% of programs incorporate assessment and preventive care of patients with special needs either in a lecture or seminar format, while only 74% reported clinical patient care experiences. Further, 49% reported that they have a noted clinical requirement for students. School settings (dental school, 4-year, 2 years) also demonstrated significant variations in instruction.

**Conclusions:** A lack of curricular uniformity exists. There is a large disparity among the types of patients treated who are designated as special needs among programs. Student clinical experiences with this population are inconsistent.

### Factors Affecting the Oral Care Practices of Texas Nurses in Hospitals

\*Stacy Pettit, RDH, BS; Ann McCann, RDH, PhD; Emet Schneiderman, PhD; Patricia Campbell, RDH, MS  
Texas A&M Health Sciences Center Baylor College of Dentistry  
Elizabeth Farren, MSN, PhD, FNP; and Louise Herrington  
Baylor University School of Nursing

Oral health care is crucial for hospitalized patients. The purpose of this study was to measure factors affecting the oral care knowledge and opinions of Texas nurses employed in hospitals. A survey was developed to measure type of patient contact, nursing education, opinions about the importance of oral care and knowledge of oral care management. The latter was a 24-question knowledge test. The IRB granted "exempt" status.

A random sample of 582 nurses was selected, and a response rate of 26% (152/582) was obtained. Data analysis with SPSS included using frequencies, Chi Square, and Spearman correlation. The mean number of years in practice was 18 (sd=11). The majority had ten or more daily patient contacts (55%). A large group of nurses (42.9%) reported feeling responsible for the oral care management of their patients and assessing the oral cavity of their patients (78.6%). Their hospital required them to assess the oral cavity (61.2%) as well as their nurse manager (50%). They reported being "minimally prepared" by their nursing program for oral care management (median=2, on a scale 1 to 4).

Only 25 respondents had attended a continuing education course regarding oral care management, with 13 only taking

one course. Most reported they were "knowledgeable" about oral health management (57.1%), yet the mean score for knowledge questions was only 50% (sd=13%). Years of practice was significantly correlated to the knowledge test score ( $\rho = .204$ ,  $p = .046$ ), as well as the nurses' self-assessment of their knowledge ( $\rho = .254$ ,  $p = .012$ ). Education level ( $\rho = .136$ ,  $p > .05$ ) was not significantly correlated to the knowledge test score.

This lack of knowledge about oral health management indicates a need for further education, such as continuing education for nurses or interdisciplinary curricula for nurses and dental hygienists. This also suggests the possibility of employing dental hygienists in hospitals for providing oral care.

### Journaling as a Method of Stress Reduction and Coping for First Year Dental Hygiene Students

\*W. Gail Barnes, RDH, PhD; Vanessa Faison, RDH, MHA/Ed  
Clayton State University  
Rosetta Watkins, RDH, BA

The first year of most professional programs can be stressful for students. The dental hygiene programs are no exception. Journaling is a method of exploring the thoughts and feelings associated with the experience. According to empirical research, journaling has been shown to decrease health symptoms, improve cognitive performance, strengthen one's immune system and counteract the harmful effects of stress.

First year dental hygiene students were required to record weekly journal entries for their pre-clinic lecture and lab courses via Blackboard's Discussion section. A survey was administered to the same students (N=24; 100% response rate) at the end of their second semester. The survey consisted of 22 items (qualitative open-ended and closed-ended questions) and was administered via the Blackboard Assessment section of their clinical course. Students were instructed to logon to the Blackboard site and complete the survey. Blackboard provided an analysis for the survey which included means, standard deviations, medians, and a list of responses from the qualitative questions.

The results indicated that the students were "comfortable writing weekly journal entries knowing that only the course director would read them" (87%). The students reported that what they liked most about journaling was that they were able to reflect on their feelings when in lab (69.6%); felt less stressed after writing their weekly journal entry (8.7%) and their confidence in instrumentation skills was increased when they read their previous journal entries (17.4%) which in turn helped to reduce their stress level when learning new instrumentation skills.

It can be concluded from the present study that the dental hygiene students were comfortable writing weekly journal entries and that journaling reduced their stress level but not to the extent of other empirical studies. Furthermore, it can be speculated that the respondents participated in other stress reduction activities while first year dental hygiene students.

## Magnifying Loupes in U.S. Entry-Level Dental Hygiene Programs: Occupational Health and Safety

\*Leslie McHaney Congdon, RDH, BSDH, MS(c); Susan Lynn Tolle, BSDH, MS; and Michele L. Darby, BSDH, MS  
*Old Dominion University*

Use of magnification loupes has increased in dental practice settings owing to enhanced visual acuity and potential ergonomic benefits recognized by OSHA and the ADA. However, minimal research has been conducted on magnification practices in schools of dental hygiene.

The purpose of this study was to determine policies concerning the use of magnifying loupes by students and faculty in United States Dental Hygiene Programs. A 31 item, self-designed questionnaire was e-mailed to all 303 accredited entry-level dental hygiene programs.

An overall response rate of 77.8% (N=236) was obtained for analysis. Results reveal the vast majority of programs do not require loupes for faculty or students with only twenty-three percent of responding schools requiring students to purchase loupes and only 8% requiring faculty to use loupes.

Most programs (90%) do not plan to require students to purchase loupes in the near future although the majority (73%) believes proper use of loupes should be integrated into the curriculum. Over 90% believe the greatest advantages of loupes are improved periodontal probe readings and ergonomics; followed by caries detection (70.2%) and decreased muscular pain (69.7%).

Cost of magnification loupes was cited as their primary disadvantage. Although 77% of respondents believe loupes are essential in private practice and acknowledge advantages to the use of loupes results suggest clinical policies may not correlate with beliefs and personal standards of care. Educational programs in dental hygiene appear unhesitant to adopt and require the use of loupes. Funding for this research project through ADHA IOH.

## Use of Complementary and Alternative Medicine for Work-Related Pain Correlates with Career Satisfaction Among Dental Hygienists

\*Aubree M. Chismark, RDH, BS; Alice E. Curran, DMD, MS; Margot B. Stein, PhD; Tabitha Tavoc, RDH, PhD; and Gary N. Asher, MD, MPH  
*University of North Carolina at Chapel Hill*

Chronic musculoskeletal pain (CMSP) is associated with work stress and burn-out among registered dental hygienists (RDHs), with prevalence estimates ranging between 64.0-93.0%. Complementary and Alternative Medicine (CAM) therapies can be helpful in managing CMSP.

The purpose of this study was to determine if RDHs who use CAM have greater career satisfaction than those who use Conventional Therapy (CT).

ADHA members (N=2431) in North Carolina (N=573) and California (N=1858) were surveyed. Data were analyzed using univariate and bivariate analyses, and logistic regression. We received a response rate of 25.3% (n=617), of which 76.5% (n=472) suffered from CMSP. Any CAM or CT use was reported

among 80.7% (n=381) of RDHs with CMSP. CAM users reported greater overall health (79.3% vs. 54.0%,  $p<0.001$ ), career satisfaction (59.2% vs. 39.0%,  $p<0.001$ ), and were able to work the hours they wanted (69.8% vs. 64.0%,  $p<0.001$ ) when compared to CT users. Of those with CMSP, 36.4% (n=172) considered a career change and 13.0% (n=59) reported having left dental hygiene due to CMSP. Those with CMSP were less likely to recall that ergonomics were reinforced during clinical training.

We can conclude that: 1) Ergonomics education may help reduce the number of RDHs who suffer from CMSP; 2) CAM therapies may improve quality of life and enhance career satisfaction for RDHs who suffer from CMSP. Future research should examine incorporating CAM, such as yoga stretches, and ergonomic education into the dental hygiene curriculum. For those who suffer work-related CMSP, CAM therapies may improve work quality, quality of life, and career satisfaction.

Funding for this project through ADHA IOH (09-01).

## Interprofessional Education Through an Oral Health Curriculum to Physician Assistant Students

\*Kelly Anderson, RDH, MHS; Barbara Smith, PT, PhD; and Denise Maseman, RDH, MHS  
*Wichita State University*

**Introduction:** As the link between oral and overall health becomes more evident to health professionals outside of dentistry, integration of oral health education is an appropriate goal for health professional education.

Interprofessional Education (IPE) is the process by which a group of students or workers from health-related occupations learn together during parts of their education.

**Purpose:** The purpose was twofold: to evaluate the implementation of an oral health curriculum to physician assistant (PA) students; identify which parts were most important in changing the PA students' knowledge regarding oral health.

**Method:** Didactic and laboratory sections were offered. Data collected were from a pre-/post-test of 24 items answered on a 5-point Likert scale, reflecting an attitudinal measure of students' (n=43) ability to apply and understand the oral health curriculum. Chi-square analyses determined if a relationship existed between answers on the same instrument before and after instruction. IRB approval was obtained and the students gave informed consent.

**Results:** Students felt they improved their level of understanding on all topics. Data were organized from the largest change in perceived competency (> 70%) from pre to posttest (8 items), moderately changed (60-69%) (6 items), and to least changed (35-59%) (10 items). The items with the largest change included: monitor impact of medications on oral tissues, recognize caries and oral lesions that require referral, and recognize signs/symptoms of gingivitis and periodontal disease.

**Conclusion:** The results indicate that the curriculum enhanced the perceived oral health competency of these PA students and their ability to recognize oral signs/symptoms that may impact a patient's general health. Overcoming the challenges of integrating health professional curriculum can ultimately benefit health professionals and patients.

# Author Guidelines

## Editorial Staff

### Editor-in-Chief

Rebecca Wilder, RDH, MS

### Administrative Editor

Jeff Mitchell

### Staff Editor

Josh Snyder

### Editor Emeritus

Mary Alice Gaston, RDH, MS

## Statement of Purpose

The *Journal of Dental Hygiene* is the refereed, scientific publication of the American Dental Hygienists' Association. It promotes the publication of original creative work related to dental hygiene research, education and evidence-based practice. The *Journal* supports the development and dissemination of a unique dental hygiene body of knowledge through scientific inquiry in basic, behavioral, clinical and translational research.

## Author Guidelines

Starting with the Summer 2004 issue, the *Journal* has been published online. The online format provides searching capabilities to *Journal* readers by establishing a link to dental hygiene research indexed through the National Library of Medicine and Medline.

## Manuscript Requirements

Manuscripts are evaluated for quality, depth and significance of research, comprehensive evaluation of the available literature and the expertise of the author(s) in the given subject. Content must provide new information and be of general importance to dental hygiene. The *Journal* discourages submitting more than one article on related aspects of the same research. If multiple papers are submitted from the same project, significant differences in the papers must be evident.

## Originality

Manuscripts must be original, unpublished, owned by the author and not submitted elsewhere. Authors are responsible for obtaining permission to use any materials (tables, charts, photographs, etc.) that are owned by others. Written permission to reprint material must be secured from the copyright owner and sent to ADHA when the manuscript is accepted for publication. The letter requesting permission must specifically state the original source, using wording stipulated by the grantor.

## Disclosure

Authors are obligated to identify any actual or potential conflict of interest in publishing the manuscript. This includes association with a company that produces, distributes or markets any products mentioned, or with funding provided to help prepare the manuscript. Disclosures should appear at the beginning of the manuscript.

## Manuscript Categories

The *Journal* publishes original scientific investigations, literature reviews, theoretical articles, brief reports, and special feature articles related to dental hygiene. Specific Categories of articles are as follows: Research, Critical Issues in Dental Hygiene, Innovations in Education and Technology, Literature Reviews and Short Reports. All submissions are reviewed by the editor and by members of the Editorial Review Board.

**Original Research Reports – limited to 4000 words (excluding references and Tables/Figures)**

Include reports of basic, behavioral, clinical and translational studies that provide new information, applications or theoretical developments. Original Research Reports include an Abstract, Introduction (including the review of the literature and ending with a statement of the study purpose), Methods and Materials, Results, Discussion and Conclusion.

**Title Page:** This page should include: 1) title of article, which should be concise yet informative, 2) first name, middle initial and last name of each author, with highest academic degrees, 3) each author or coauthor's job title, department and institution or place of employment if other than academic, 4) disclaimers/disclosures, if any, 5) name, address, all contact information of author responsible for correspondence about the manuscript and 6) funding sources for the project, equipment, drugs, etc.

**Abstract:** Approximately 250 words. Use the headings "Purpose" (purpose), "Methods" (design, subjects, procedures, measurements), "Results" (principal findings), and "Conclusion (i.e. Major conclusions.)" The abstract must be able to stand alone. References should therefore be avoided.

**Keywords:** Four to ten keywords should be chosen that are consistent with Medical Subject Headings (MSH) listed in Index Medicus. These key words will be used for indexing purposes. Keywords should be listed at the end of the abstract.

**NDHRA:** Identify how the study supports a specific topic area and related objective from the National Dental Hygiene Research Agenda. For example: This study supports the objective: Assess strategies for effective communication between the dental hygienist and the client, under Health Promotion/Disease Prevention. NDHRA statements can be found at: [http://www.adha.org/downloads/Research\\_agenda%20-ADHA\\_Final\\_Report.pdf](http://www.adha.org/downloads/Research_agenda%20-ADHA_Final_Report.pdf)

**Text:** The body of the manuscript should be divided into sections preceded by the appropriate subheading. Major subheadings should be in capital letters at the left-hand margin. Secondary subheads should appear at the left-hand margin and be typed in upper and lower case and in bold face.

**Introduction (including the literature review):** Cite a variety of relevant studies that relate to the need for the current study and its significance. References should be as current as possible, unless a hallmark study is included. Compare findings of previous studies, clearly indicating all sources of concepts and data. When a source is directly quoted, use quotation marks. However, use of quotation marks should be limited. End this section with a clear statement of the purpose of the study, hypothesis or research objectives.

**Methods and Materials:** Describe the research design (e.g. randomized controlled trial) and procedures (e.g. IRB approval, target population, inclusion/exclusion criteria, recruitment, informed consent, variables to be tested, instruments, equipment, procedures and method of data analysis). Specify the measurements and statistical tests used as well as related levels of significance. Furthermore, assure an adherence to all pertinent federal

and state regulations concerning the protection of the rights and welfare of all human and animal subjects.

**Results:** Summarize all relevant data and study findings. Do not repeat in the text the data reported in tables and figures verbatim, but do refer to the data and emphasize important findings (e.g. Table 1 shows that most of the subjects were African American and between the ages of 12 and 16).

**Discussion:** Evaluate and interpret the findings. Compare them with those of other related studies. Discuss how they relate to dental hygiene practice, profession, education or research. Include overall health promotion and disease prevention, clinical and primary care for individuals and groups and basic and applied science. Discuss study limitations; implications for dental hygiene practice, education, and research; and recommendations or plans for further study.

**Conclusion:** State the conclusions, theories, or implications that may be drawn from the study. This section should be 1-2 paragraphs or can be listed as bulleted points.

**Acknowledgments:** Be brief and straightforward. Example: "The authors thank Jane Smith, RDH, for her assistance in developing the survey instrument." Anyone making a substantial contribution to the conduct of the research or the resulting report should be appropriately credited as an author.

### **Literature Reviews – limited to 3000 words (excluding references and Tables/Figures)**

A presentation of relevant and primary published material on a specific topic constitutes a comprehensive literature review. Such a review includes a summary and critique of the current status of the topic, and the aspects requiring further study.

**Abstract:** Literature reviews begin with a non-structured abstract—a brief statement of purpose, content summary, conclusions, and recommendations.

**Keywords:** At least four keywords should be listed following the non-structured abstract.

**NDHRA:** Identify how the literature review supports a specific topic area and related objective from the National Dental Hygiene Research Agenda. For example: This review supports the objective: Assess strategies for effective communication between the dental hygienist and the client, under Health Promotion/Disease Prevention.

### **Short Reports – limited to no more than 2000 words plus references and illustrations. Illustrations should be limited to a total of no more than 2 (e.g. 2 figures or 2 tables, or 1 figure and 1 table)**

The *Journal* publishes short reports related to dental hygiene. Short reports are limited in scope and should begin with a brief, non-structured abstract that describes the topic. The abstract should contain at least four keywords. Identify how the report supports a specific topic area and related objective from the National Dental Hygiene Research Agenda. A concise introduction; literature review; detailed description of the topic or activity; and discussion, conclusion, and recommendations must also be included. References are necessary to support the rationale and methods presented.

A short report may describe a clinical case study, an educa-

tional innovation, a research method, a concept or theory, or other current topics.

**Case Study:** A report that describes a unique aspect of patient care not previously documented in the literature. Such reports usually focus on a single patient or groups of patients with similar conditions. Suitable topics include, but are not limited to, innovative preventive methods or programs, educational methods or approaches, health promotion interventions, unique clinical conditions or pathologies and ethical issues.

**Theoretical Manuscript:** A report that provides a well-supported explanation for natural phenomena that clarify a set of inter-related concepts, definitions, or propositions about dental hygiene care or processes. Such reports provide new knowledge, insight, or interpretation; and discussion, conclusions, and recommendations. These reports begin with a non-structured abstract. At least four keywords are listed at the end of the abstract.

### **Critical Issues in Dental Hygiene – limited to 4000 words**

The purpose of this section is to highlight challenges and opportunities pertinent to the future directions of the profession of dental hygiene.

### **Innovations in Education and Technology – limited to 4000 words**

The purpose of this section is to feature short reports of innovative teaching applications and techniques as well as new technologies available for increased communication and learning in dental hygiene education.

### **Manuscript Preparation and Style**

Standard usage of the English language is expected. Manuscripts should be created in Microsoft Word with margins of at least 1 inch. Double spacing should be used throughout the manuscript. Font size is 12 point in Times New Roman style. All pages should be numbered, consecutively beginning with title page, to include references, tables and legends for illustrations. Begin each of the following sections on separate pages: title page, abstract and key words, text, acknowledgements, references, individual tables and legends. Do not embed tables and figures in the body of the text. If figures are large files, they can be submitted as separate documents. Clearly indicate who is willing to handle correspondence at all stages of the review process and publication. Ensure that telephone and fax numbers are provided for the corresponding author in addition to the email address.

Spell out abbreviations and acronyms on first mention followed by the abbreviation in parentheses. Limit the overall use of abbreviations in the text.

Throughout the text, use generic, nonproprietary names for medications, products and devices. At the first mention, state the generic name followed in parentheses by the trade name with the register® or trademark™ symbol and the manufacturer's name and city/state.

**Example:** Chlorhexidine (Peridex®; 3M ESPE, Minneapolis, MN) coded or abbreviated as CHX

### **Author Biography**

Please include a brief biographical sketch of each author at the beginning of the manuscript. List names, credentials, titles,

affiliations and locations. Example: “Mary B. Jones, RDH, MA, is assistant professor and clinic director, Department of Dental Hygiene; Bill R. Smith, DDS, MED, is associate professor, Department of Pediatric Dentistry. Both are at the University of Minnesota in Minneapolis.”

## Visual Aids

**Tables:** All tables must have a title that is brief but self-explanatory. Readers should not have to refer to the text to understand a table. Also, the main body of text should not overly depend on the tables. Indicate explanatory notes to items in the table with reference marks (\*, #). Cite each table in the text in the order in which it is to appear. Identify tables with Arabic numbers (ex: Table 1).

**Figures:** Includes charts, graphs, photographs, and artwork. All should include a brief caption and use Arabic numerals (ex: Figure 1). Cite each figure in the text in the order in which it will appear.

**Photographs:** High-resolution digital photos are preferred, with a resolution of at least 300 pixels per inch. Submitting two positive prints of each quality photograph is also permitted. Color prints are preferred over black-and-white prints. Photographs are not returned unless requested by authors.

## References

The *Journal* follows National Library of Medicine (NLM) citation style. Please refer to <http://medlib.bu.edu/facts/faq2.cfm/content/citationsnlm.cfm> for specifics.

Each reference should be numbered in the order it first appears in the text. If a source is cited more than once, the first reference number it is given is used throughout. Each reference in the text should be in superscript format. Continuous references should be connected with a dash (example: 7, 8-10). ADHA editorial staff does not assume responsibility for verifying references. For more information and detailed examples, please visit the International Committee of Medical Journal Editors at [www.icmje.org](http://www.icmje.org). Please ensure that every reference cited in the text is also present in the reference list and vice versa. Citation of a reference as “in press” implies that the item has been accepted for publication.

Please list all authors. Capitalize only the first word of the journal article title, and use the NLM journal abbreviations found at [www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=journals](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=journals). If more than 6 authors are listed, list the first 3 followed by et al.

### Examples of reference citations:

**Example Article in a Journal:** Michalowicz BS, Hodges JS, DiAngelis AJ et al. Treatment of periodontal disease and the risk of preterm birth. *N Engl J Med*. 2006;355(18):1885-1894.

Smith MA, Jones BB. Curette sharpness: a literature review. *J Dent Hyg*. 1996;77:382-390.

**Article from a Journal published online only:** Hollister MC, Anema MG. Health behavior models and oral health: a review. *J Dent Hyg* [Internet]. 2004 [cited 2005 Feb 17];78(3):e6. Available from <http://www.adha.org>. Registration required for access.

**Book citations:** Spolarich AE, Gurenlian JR. Drug-induced adverse oral events. In: Daniel SJ, Harfst SA, Wilder RS, ed.

Mosby's Dental Hygiene: Concepts, Cases and Competencies. 2nd ed. St. Louis, MO. Mosby/Elsevier Publishing. 2008. p. 259-276.

**Internet citations:** NLM requires the standard elements of a citation for an Internet resource, with a few modifications. The main elements required:

Polgreen PM, Diekema DJ, Vandenberg J, et al. Risk factors for groin wound infection after femoral artery catheterization: a case-control study. *Infect Control Hosp Epidemiol* [Internet]. 2006 Jan [cited 2007 Jan 5];27(1):34-7. Available from: <http://www.journals.uchicago.edu/ICHE/journal/issues/v27n1/2004069/2004069.web.pdf>

Poole KE, Compston JE. Osteoporosis and its management. *BMJ* [Internet]. 2006 Dec 16 [cited 2007 Jan 4];333(7581):1251-6. Available from: <http://www.bmj.com/cgi/reprint/333/7581/1251?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=relevance&volume=333&firstpage=1251&resourcetype=HWCIT>

## Manuscript Submission

Manuscripts should be submitted as a Microsoft Word attachment via email to the Staff Editor, Josh Snyder at [joshes@adha.net](mailto:joshes@adha.net). There is no charge for submission. The ADHA Communications Division will acknowledge receipt of the submission by email.

Each manuscript is assigned a log number, which authors should use for correspondence. All papers are reviewed by the editor, blinded to remove any author identification and assigned to three reviewers. The editor reserves the right to return, without review, any manuscript that does not meet *Journal* criteria for formal review.

The review process takes approximately 10 to 12 weeks, depending on the need for authors to make revisions. All reviewer comments, as well as notification of acceptance or rejection, are submitted to the corresponding author.

## Publication

Accepted manuscripts are edited and sent to the principal author for approval of technical accuracy. Editors reserve the right to edit or rewrite copy to fit the style requirements of the *Journal*. All authors must sign agreements that permit the article to be published and to transfer copyright.

For further information, please contact the *Journal of Dental Hygiene* by phone at 312-440-8900 or by e-mail at [communications@adha.net](mailto:communications@adha.net).

## Author's Responsibilities

### Personal communications and unpublished data

The *Journal* requires that authors request and receive permission from each person identified in the manuscript as a source of information in a personal communication or as a source for unpublished data. By submitting their manuscripts, authors represent and warrant to the *Journal* that such permission has been obtained, if applicable. The *Journal* strongly recommends that such permissions be in writing and that authors should maintain the signed statements in their records for a reasonable period of time after publication of their work in the *Journal*. Authors must

specify in the manuscript the date of the communication or the data, as well as whether the communication was written or oral.

Example: Additionally, the efforts of the office administrator, with regard to accommodating schedules and financing, could have been a factor (Vaccari, personal communication, April 2008).

### Copyright transfer

The American Dental Hygienists' Association owns the copyright for all editorial content published in the *Journal*. An author agreement form, requiring copyright transfer from authors, signed by each author, must be signed before the manuscript is published in the *Journal*. Manuscripts without a signed author agreement form will not be published until the *Journal's* Editorial office receives a valid, executed author agreement form from each author. If the manuscript is rejected by the *Journal*, all copyrights in the manuscript will be retained by the author(s). All accepted manuscripts and their accompanying illustrations become the permanent property of the American Dental Hygienists' Association and may not be published elsewhere in full or in part, in print or electronically, without written permission from the ADHA's Communications Division.

### NIH Open Access Policy

National Institutes of Health Public Access Policy: Authors' Responsibilities – The National Institutes of Health (NIH) Public

Access Policy implemented a law passed in December 2007 that affects authors who receive funding from the NIH. As of April 7, 2008, all peer-reviewed articles that arise, in whole or in part, from direct costs funded by NIH, or from NIH staff, that are accepted for publication by a peer-reviewed journal—including JDH—must be deposited with the National Library of Medicine's PubMed Central, in the form of a copy of the manuscript's final version on its acceptance. Please see the following NIH site regarding questions that authors may have about the policy: <http://publicaccess.nih.gov>.

For *Journal* papers, when the author deposits the accepted manuscript with PubMed Central, he or she should specify that the manuscript is not to be made available until 12 months after publication (not acceptance). Thereby, the manuscripts will be made publicly available by PubMed Central at the same time that the *Journal* makes its full text available to the public free of charge.

JDH holds the copyright to all published material except for material authored solely by U.S. government employees. Please see the *Journal* Author Agreement form (PDF) for further details. The Policy applies to any author of a manuscript that is peer-reviewed, is accepted for publication on or after January 1, 2011 and, arises from one of the following: any direct funding from an NIH grant or cooperative agreement active in Fiscal Year 2008 or beyond, any direct funding from an NIH contract signed on or after April 7, 2008, any direct funding from the NIH Intramural Program or an NIH employee.

## Errata

The printed version of the Summer 2010 issue of the *Journal of Dental Hygiene* contained the following errors in the manuscript titled "Bisphenol A Blood and Saliva Levels Prior To and After Dental Sealant Placement In Adults."

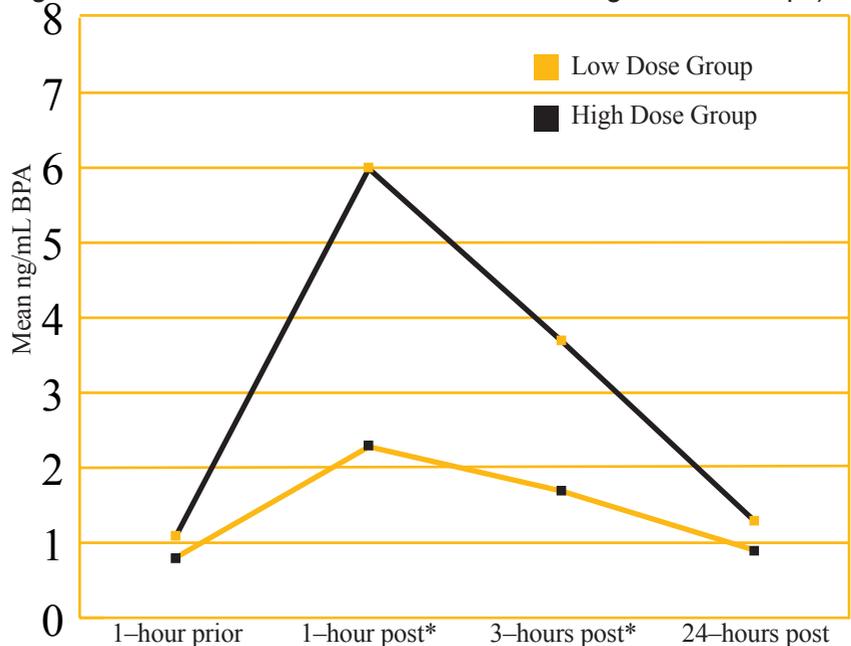
- Reference citations on page 146 were mislabeled. The affected sentences are printed below.
- Figure 2 was missing the legend. The figure has been reprinted.
- The first sentence of the conclusion contained out-dated information. The new sentence is reprinted below.

The editorial staff of the *Journal of Dental Hygiene* regret these errors.

*Corrected content from page 146*

A daily ingestion value can be estimated at <1 µg BPA/kgBW/day, and is believed to be the main source of human exposure.<sup>27-30</sup> The U.S. Environmental Protection Agency estimates a safe dose calculated at 50 µg BPA/kgBW/day.<sup>31</sup>

Figure 2. Overall Salivary BPA Concentration (\*Indicates statistical Significant Difference Between Low-Dose and High-Dose Groups)



### Conclusion

Dental professionals should adopt products which do not release BPA and

implement protocols as recommended in the evidenced-based research to reduce patients exposure to BPA.

specify in the manuscript the date of the communication or the data, as well as whether the communication was written or oral.

Example: Additionally, the efforts of the office administrator, with regard to accommodating schedules and financing, could have been a factor (Vaccari, personal communication, April 2008).

### Copyright transfer

The American Dental Hygienists' Association owns the copyright for all editorial content published in the *Journal*. An author agreement form, requiring copyright transfer from authors, signed by each author, must be signed before the manuscript is published in the *Journal*. Manuscripts without a signed author agreement form will not be published until the *Journal's* Editorial office receives a valid, executed author agreement form from each author. If the manuscript is rejected by the *Journal*, all copyrights in the manuscript will be retained by the author(s). All accepted manuscripts and their accompanying illustrations become the permanent property of the American Dental Hygienists' Association and may not be published elsewhere in full or in part, in print or electronically, without written permission from the ADHA's Communications Division.

### NIH Open Access Policy

National Institutes of Health Public Access Policy: Authors' Responsibilities – The National Institutes of Health (NIH) Public

Access Policy implemented a law passed in December 2007 that affects authors who receive funding from the NIH. As of April 7, 2008, all peer-reviewed articles that arise, in whole or in part, from direct costs funded by NIH, or from NIH staff, that are accepted for publication by a peer-reviewed journal—including JDH—must be deposited with the National Library of Medicine's PubMed Central, in the form of a copy of the manuscript's final version on its acceptance. Please see the following NIH site regarding questions that authors may have about the policy: <http://publicaccess.nih.gov>.

For *Journal* papers, when the author deposits the accepted manuscript with PubMed Central, he or she should specify that the manuscript is not to be made available until 12 months after publication (not acceptance). Thereby, the manuscripts will be made publicly available by PubMed Central at the same time that the *Journal* makes its full text available to the public free of charge.

JDH holds the copyright to all published material except for material authored solely by U.S. government employees. Please see the *Journal* Author Agreement form (PDF) for further details. The Policy applies to any author of a manuscript that is peer-reviewed, is accepted for publication on or after January 1, 2011 and, arises from one of the following: any direct funding from an NIH grant or cooperative agreement active in Fiscal Year 2008 or beyond, any direct funding from an NIH contract signed on or after April 7, 2008, any direct funding from the NIH Intramural Program or an NIH employee.

## Errata

The printed version of the Summer 2010 issue of the *Journal of Dental Hygiene* contained the following errors in the manuscript titled "Bisphenol A Blood and Saliva Levels Prior To and After Dental Sealant Placement In Adults."

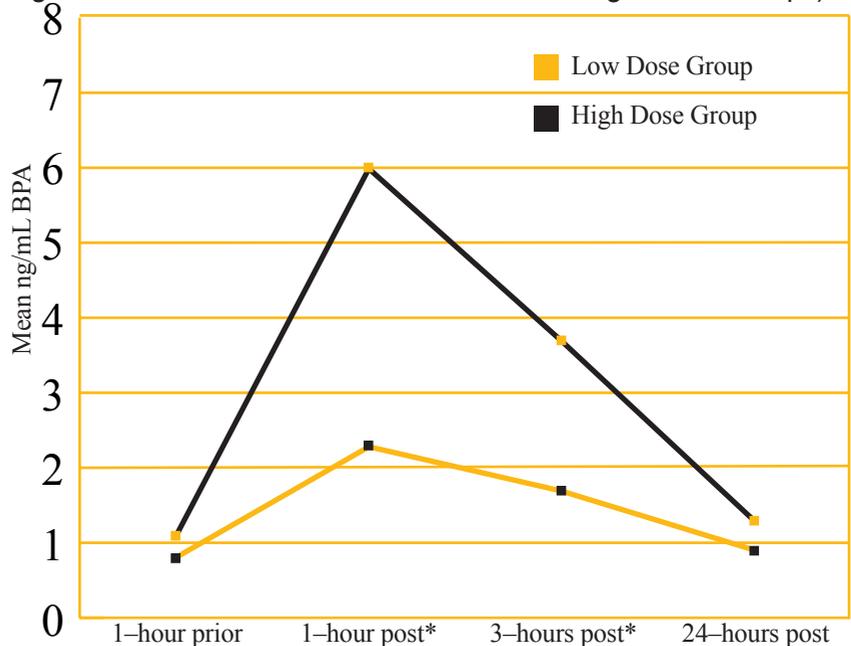
- Reference citations on page 146 were mislabeled. The affected sentences are printed below.
- Figure 2 was missing the legend. The figure has been reprinted.
- The first sentence of the conclusion contained out-dated information. The new sentence is reprinted below.

The editorial staff of the *Journal of Dental Hygiene* regret these errors.

*Corrected content from page 146*

A daily ingestion value can be estimated at <1 µg BPA/kgBW/day, and is believed to be the main source of human exposure.<sup>27-30</sup> The U.S. Environmental Protection Agency estimates a safe dose calculated at 50 µg BPA/kgBW/day.<sup>31</sup>

Figure 2. Overall Salivary BPA Concentration (\*Indicates statistical Significant Difference Between Low-Dose and High-Dose Groups)



### Conclusion

Dental professionals should adopt products which do not release BPA and

implement protocols as recommended in the evidenced-based research to reduce patients exposure to BPA.