Final Reflections

MA Gaston

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Keywords: dental hygiene research, dental hygiene research journal, leadership change

As I prepare this editorial in late December of 2005, I am keenly aware that this is my final opportunity to speak to Journal of Dental Hygiene readers as Editor-in-Chief. While I have looked forward to retiring from this position for some time, the decision to give up leadership of the Journal was not easy. I suppose other former Journal editors who really loved the work must have had similar feelings upon leaving the position. Furthermore, I have recently found myself wondering if as editor I did everything I could have done to make each issue of the Journal the very best possible. I can only hope that the record will speak kindly of my efforts. After reflecting back on my experience as editor, I have chosen a few final thoughts to share with you hoping that they might be helpful to those of you who are responsible for maintaining the integrity of the Journal of Dental Hygiene.

When I was appointed editor, I had no idea I would stay in the position for seven and a half years. While I did not give much thought in the beginning to how long I would be the editor, I did think a lot about the importance of the Journal of Dental Hygiene to our profession's continuing growth and development. I remembered that in 1926 one of the first things the newly established American Dental Hygienists' Association (ADHA) did was to establish a professional journal to keep its members informed. For these reasons, I realized that becoming the Journal of Dental Hygiene editor was an enormous responsibility and an extraordinary privilege that only a very few fortunate people experience. Above all, I knew that I had best not mess up in such a highly visible position. There are many reasons to believe that the Journal is stronger now than it was when I took over as its editor July 1, 1997. I do not claim the credit for this, but share it with others such as the ADHA talented staff editors, dedicated members of the Journal review board, authors, and ADHA leaders and members who offered encouragement all along the way. I encourage everyone to give the same level of support to the new editor-in-chief as she takes on the challenges of leading the Journal forward over the coming years. The knowledge of your support should give her the confidence she will need to accomplish some of the important initiatives that will make our Journal even better.
As editor, my primary goal from the very beginning was to see that the Journal of Dental Hygiene fulfilled its purpose as the ADHA refereed, scientific publication, and the dental hygiene profession's premier research journal. I was particularly sensitive to the need to publish reports of original and innovative work that added to the dental hygiene body of knowledge through scientific inquiry in basic, applied, and clinical research. In recent years I was more and more impressed by the public health related scientific studies and projects being undertaken by dental hygienists in various settings all over the world. I felt strongly the importance of documenting such work in the literature, and therefore, encouraged individual investigators to submit their reports for publication in JDH. This part of my work was very satisfying because I was privileged to read such reports before everyone else. It was really exciting to me personally to know who was doing what kind of work, where, and when. I believe it is urgent that this dental hygiene research be encouraged, continued, and reported in JDH. I know that our new editor-in-chief feels a strong commitment to continue to focus on this primary purpose of the Journal of Dental Hygiene and I hope you will support her efforts in this regard.

I want to talk a bit about the Journal of Dental Hygiene format. No one is more aware than I that changing to the electronic format had a dramatic affect on some of our readers and may have resulted in fewer people actually reading the Journal regularly. While I know that the electronic format is here to stay, I am confident that the new editor-in-chief plans to explore ways to ease the transition from paper copy to online copy and to increase JDH readership. The major point I think we should remember is that the Journal contains high quality dental hygiene scientific reports, regardless of whether it is delivered in paper or online format. Yes, it may take a little more effort to access those reports online, but accessing them is worth the effort. It may also mean that dental hygiene educators will have to require their students to regularly access the Journal online to complete reading assignments as a part of regular classroom and clinical education so that they will develop the habit of reading it online while they are students. It also may mean that the ADHA will have to develop ways to remind subscribers when issues are published and available. We simply must read the latest dental hygiene research being reported in the Journal of Dental Hygiene because that is where the majority of such research is being published. We owe it to our profession, don't we?

Finally, I want our readers and ADHA leaders and members to know what a pleasure and honor it has been to serve as editor. From the very first, you welcomed me into your hearts and gave me your complete trust and support. I will always be grateful for the kindness and the encouragement you expressed to me throughout my tenure. I thank the members of the editorial review board for their commitment to the Journal and to mentoring authors. I particularly applaud you for completing an unbiased review of each manuscript, and for the fact that you do this work as a service to our profession. I appreciate the cooperative attitude of the many authors who have submitted manuscripts during my tenure. I thank you because you have taken our suggestions and criticisms as constructive and have used them wisely, making our job easier. I want to especially thank each of the ADHA staff editors who have worked with me on the Journal of Dental Hygiene. You have each been different, but each very talented and a pleasure to work with.

Over the last month, I've thought of a scene in the movie, "Lonesome Dove," in which the colorful character, Gus, lay dying from wounds sustained in a brutal fight with the Indians. In that scene, Gus knew he was near the end of his life and, being a very brave man, was willing to accept the facts as they were. To express his life and how he had lived it, he said, "It's been one hell of a ride." While I certainly don't think I'm nearly at the end of my life, I may very well have completed the last big assignment of my dental hygiene career when I retired as editor of the Journal of Dental Hygiene. Therefore, like Gus, I'm pleased to say, "My dental hygiene career has been one heck of a ride."

My final wish is that Rebecca Wilder will treasure the position of editor-in-chief of the Journal of Dental Hygiene and that she will be encouraged by the support of her peers in dental hygiene as I have been over the past seven and a half years.
Periodontal Disease may be the Heart of Cardiovascular Problems

Brushing, flossing and regular dental checkups may help keep the heart healthy, reported experts in Circulation, the journal of the American Heart Association.

"People who have chronic infections-and gum disease is one of the major chronic infections-are at increased risk later in life for atherosclerosis [hardening of the arteries] and coronary heart disease," said Dr. Richard Stein, American Heart Association spokesman and director of preventive cardiology at Beth Israel Medical Center in New York City.

Why? Chronic periodontal disease, a persistent bacterial infection affecting the gums and bone supporting the teeth, sets off an inflammatory process that aggravates and contributes to the build-up of cholesterol-rich plaque on artery walls.

"What you are really talking about here is an inflammatory process. The body is an amazing machine that handles chronic inflammation, whether it is in the mouth or in the heart, in a similar manner," said JoAnn Gurenlian, RDH, PhD.

"Literature suggests that during periodontal inflammation, pathogens enter systemic tissue, invade the heart and coronary artery cells, induce platelet aggregation, and can cause thrombus formation. Therefore, the two diseases [periodontal diseases and cardiovascular disease] share common risks and etiologies," said Gurenlian.

According to Gurenlian, the infection that causes periodontal disease and sets up an inflammatory response leads to an increase in cellular mediators. One such mediator, C-reactive protein (CRP), is produced by the liver during periods of inflammation and causes inflammation of the arteries.

"Elevation of CRP damages the smooth muscles of the blood vessels, which can precipitate a cardiovascular event. When CRP is produced, the arterial walls that have cholesterol plaques deposited become unstable and some may rupture. If they do rupture, a clot can form leading to stroke or myocardial infarction," said Gurenlian.

Experts have known about the periodontal-cardiovascular link for about ten years, according to Stein. "It's become a bigger problem in general because we're having fewer cavities due to fluoride and we're living longer," said Stein. "So, more and more, what's making us lose our teeth is periodontal disease."

Fortunately, periodontal disease is preventable. Like exercising and eating healthy, Dr. Stein advises his patients who are worried about their risk for heart attack to incorporate good periodontal care into their everyday preventative strategy.

Gurenlian recommends that those who are at risk use a toothpaste with both antibacterial and anti-inflammatory properties. "The best and most simple things we can do is take care of our oral health. The goal is to reduce infection and inflammation as much as possible."

One lucky group of adults-those with dentures-do not have to worry about periodontal troubles. "In order to have an infection of your gums, you need to have teeth," said Stein.
"Taking care of your teeth is part of general good health and quality of life, and it may also have a protective role for your heart," said Stein.

**Acetaminophen is Leading Cause of Acute Liver Failure**

Liver toxicity from Acetaminophen poisoning is the number one cause of acute liver failure in the United States, according to researchers reporting in the December issue of *Hepatology*.

Most at risk are acetaminophen users with depression, chronic pain, alcohol/narcotic use, as well as those who take multiple acetaminophen-containing products at the same time, wrote the researchers.

"Education of patients, physicians, and pharmacists to limit high-risk [acetaminophen] use settings is recommended," wrote Anne M. Larson, MD, of the University of Washington, and colleagues at 21 other US Centers.

There is, however, no need to panic, because acetaminophen-associated liver toxicity is rare, and the drug itself is not toxic, wrote John G. O'Grady, MD, of the Institute of Liver Studies at King's College Hospital in London, in an accompanying editorial.

Rather than boycotting acetaminophen-contain products all together, O'Grady, like Larson and her colleagues, recommended an increase in education. "Education initiatives to highlight the range of preparations containing acetaminophen, together with reiteration of advice on maximum daily dosing, have potential benefits, especially with respect to unintentional overdosing."

Acetaminophen, the active ingredient in Tylenol and a variety of other pain killers is widely available in over-the-counter preparations for headaches, colds, allergies, osteoarthritis, and several other conditions.

Consistent use of as little as 7.5 grams of acetaminophen a day could lead to severe hepatic injury, wrote Dr. Larson and her colleagues. Be it intentional or accidental, consuming more than the package-recommended four grams per day is considered acetaminophen overdose, which has been associated with severe hepatic necrosis leading to acute liver failure.

Although some people deliberately take toxic doses of acetaminophen in an attempt to commit suicide, others have unintentionally accumulated high, toxic levels of acetaminophen when taking, for example, Tylenol for a headache and a second acetaminophen-containing product for cold symptoms.

According to the study's authors, N-acetylcysteine administered within 12 hours of ingestion of acetaminophen can prevent liver injury; however, many people are unaware of this course of action.

Both Larson et al and O'Grady suggest that a strategy restricting but not banning over-the-counter sales of medications containing acetaminophen may be necessary to prevent accidental overdose.

A similar approach in the United Kingdom led to a 30% reduction in patients with severe acetaminophen-induced acute liver failure after just four years.

**Women, Protect Against Heart Disease and Osteoporosis BEFORE Menopause**

Stress and fluctuating hormone levels can cause problems for women long before menopause, suggests a new study. Traditionally, it has been thought that a woman is protected from heart disease and osteoporosis until she goes through menopause. However, new research with monkeys questions that belief and suggests that the time for women to start protecting their heart and bones is during perimenopause, or preferably, even earlier.

"Most women think they don't have to worry much about chronic health problems until perimenopause or menopause," said Jay Kaplan, head of the section of comparative medicine at Wake Forest University School of Medicine. "But there's a high-risk trajectory that women can get on in their reproductive years that sets the stage for later problems."
During perimenopause, aka premenopause, which can start as early as age 35, a woman's body starts making less of the hormones estrogen and progesterone. In previous monkey studies, Kaplan found that stress reduced estrogen levels and initiated the buildup of plaque in the blood vessels.

According to Kaplan, the quality of ovarian function—the way in which the body produces estrogen and progesterone—in the premenopausal period can contribute to a woman's health status later in life. "Ovarian function varies quite a bit during the premenopausal years. And it turns out that reproductive function in both women and monkeys is easily impaired by stress," said Kaplan.

Many women never realize their ovarian function is impaired because they continue to cycle normally, said Kaplan. Unfortunately, this means that women are unknowingly being exposed to varying levels of estrogen, which can have a negative effect on both heart and bone health.

"The reality is a lot of heart health begins before menopause," said Dr. Steven Goldstein, an obstetrician/gynecologist at New York University Medical Center. "Perimenopause is an excellent opportunity to begin a self-assessment and medical report card. Develop a plan with your doctor for your overall health, diet and lifestyle for the second half of your life."

Until more is research has been completed on the effects of premenopausal estrogen therapy, Kaplan recommends that women try to reduce stress wherever possible.

"Stress does matter. In fact, it matters in ways that women probably don't recognize. Try to learn new coping skills for stress, and extend your social networks," advised Kaplan.
Review of: Culture and Clinical Care

Cassandra Holder-Ballard

Reviewed by Cassandra Holder-Ballard, RDH, MPA, associate professor of dental hygiene at the University of Tennessee, Health Science Center, in Memphis, Tennessee.

Culture and Clinical Care

1st Edition

Lipson JG and Dibble SL

UCSF Nursing Press, 2006

San Francisco, California

487 pages, indexed, soft cover

ISBN 0-943671-22-1

$33.95

*Culture and Clinical Care* is a guidebook designed for use by clinicians who work with culturally diverse clients. This soft-backed text is not designed to be used as an instructional textbook, but rather as a starting point in understanding a variety of cultural/ethnic groups.
The book's introduction is entitled, "Providing Culturally Appropriate Health Care." This section provides a framework for understanding the significance culture plays in the provision of health care. The subtopics in this section are "Limitations of Information," "Sources of Diversity," "Variations in Communication," and "Communication and Interpreters."

This book is composed of 35 chapters. Each chapter addresses a specific cultural/ethnic group. The cultural groups were selected based on population size; according to the United States (U.S.) Census each group numbers at least 100,000. Chapters are arranged alphabetically, beginning with Afghans and ending with (former) Yugoslavians. Each chapter is authored by 1 to 3 individuals who are members of the cultural/ethnic group, or are uniquely connected to the group. Most of the authors are nurses with advanced degrees. Other authors have advance degrees in areas such as public health or social anthropology.

Chapters follow a common sequence. There are 12 major headers, and each contains 3 to 15 subtopics. The first header is "Culture/Ethnic Identity." There are three subtitles for this header. The first is a discussion of the preferred terms for identifying members of this group. Next, a census report of the population is provided, including where the largest numbers reside. Some other interesting headers are "Spiritual/Religious Orientation," "Food Practices," "Symptom Management," and "Death Rituals."

"Communication" appears to be the most involved section for every chapter. Discussions in this area include major languages and dialects, tone of voice, styles of speech, and the use of interpreters. Written communication is also addressed, regarding literacy assessment and consents. Last, nonverbal communication is addressed. Some of the subtitles for this topic are "Eye Contact," "Personal Space," "Meaning of Silence," "Gestures," and "Orientation of Time."

Other extensive sections are, "Birth Rituals," "Developmental and Sexual Issues," "Family Relationships," and "Illness Beliefs." The "Birth Rituals" section covers pregnancy to delivery as well as baby care. "Developmental and Sexual Issues" section provides insight on attitudes toward birth control, STDs, abortion, and sexual orientation. The "Family Relationships" section offers information about family structure, decision making, roles of family members, and expectations of and for children. Finally, the "Illness Beliefs" section discusses the concept of health and prevention and ends with common health problems.

The editors stress that there is considerable variation in every cultural group. They caution that chapters in this book should not be used as blueprints for patient characteristics. Their purpose is to alert clinicians to potential factors that they should consider in providing appropriate care.

Culture and Clinical Care is an excellent resource for many health care providers, especially those who deliver direct patient care. The text provides easy access to information pertaining to specific cultural/ethnic groups. However, the reader must remember that the information provided is not a substitute for individualized patient interaction.
Review of: Essentials of Dental Hygiene: Preclinical Skills

Patricia A Frese

Reviewed by Patricia A. Frese, RDH, MEd, associate professor of dental hygiene at the University of Cincinnati, Raymond Walters College, in Cincinnati, Ohio.

Essentials of Dental Hygiene: Preclinical Skills

1st Edition

Cooper MD, Wiechmann L

Pearson Prentice Hall, 2005

Upper Saddle River, New Jersey

321 pages, illustrated, indexed, soft cover with CD-ROM


$38.60

The authors' intent for this text is to have the first-year, first-semester dental hygiene student learn the basic skills necessary to provide initial dental hygiene care in the clinical setting. The authors recognize that additional skill sets are required for comprehensive care and are planning a follow-up textbook covering these additional skills and services. The text is written in an outline format that the first-time reader can easily read and scan when reviewing the material. The 10 chapters, written by the authors and expert contributors, are presented in the order of patient treatment. While this text is primarily written for the dental hygiene student, it is of value to the dental hygiene practitioner who wants a skills review, and for faculty calibration as well.
The focus and design of the text make the information and skills immediately applicable to patient treatment. The chapters begin with a glossary of key terms with definitions and a list of learning objectives. The core content of each chapter is presented in a step-by-step sequence with enough background information to contribute to critical thinking, thus avoiding performance of skills without understanding. There are "Preclinical Tip" boxes throughout, which provide interesting information that will strengthen the reader's knowledge. The boxes are cleverly subtitled to match the intent of each chapter. There are tables, charts, diagrams, photographs, and sample forms that are supported by and help to further explain the written text. The chapters end with skill sheets and multiple-choice questions that can be used by the student for practice and/or by the instructor for evaluation. A list of references completes each chapter.

The photographs in the text are in black and white. There are pages at the end of the text that have some of these photographs in color so the learner can begin to appreciate the importance of normal and abnormal coloration of the head and neck regions.

Additionally, there is a CD-ROM with the text. The reader is directed to this feature at the beginning of every chapter. The CD contains a photo gallery that has color versions of the black and white photographs presented in the text. This allows the reader to view the correct coloration in a more cost-effective manner than a full-color text. The CD also contains video clips of the skills. These techniques videos include infection control, extra- and intraoral examinations, charting, instrumentation for both right- and left-handed practitioners, blood pressure measurement, polishing, oral physiotherapy (OPT) aids, and fluorides. QuickTime is necessary to view these short video clips and can be downloaded from the CD. The student can use the CD as self-study or the instructor can present the information in class.

Overall, the text is applicable to a wide audience. The information is complete and current. The CD-ROM is a useful addition and makes good use of current technology to provide additional information while keeping costs reasonable. For the second edition of the text, the authors should consider providing the answers to the review questions as well as the page numbers where the material is presented. This will make the questions more useful to the beginning learner as well as for the student reviewing for board exams.
Review of: Oral Pathology for the Dental Hygienist

Joan C Gibson-Howell

Reviewed by Joan C. Gibson-Howell, RDH, MSEd, EdD.

Oral Pathology for the Dental Hygienist

4th Edition
Ibsen OAC, Phelan JA
Saunders, 2004
St. Louis, Missouri
395 pages, illustrated, indexed
ISBN: 0-7216-9946-4
$72.95

The fourth edition of Oral Pathology for the Dental Hygienist is an affirmation of the popularity of the text and the authors' desire to produce a valued resource for the dental hygiene learner and teacher of oral pathology. As stated in the preface, this text now includes 10 chapters which exemplify the authors' efforts to adequately cover, enhance, expand, and clearly relay information to students and practitioners. For example, in the previous edition, the chapter on immunology was longer, but is now separated into 2 chapters: Chapter 3, "Immunology" and Chapter 4, "Infectious Diseases." In addition, although nonneoplastic bone diseases information was included throughout the previous edition, Chapter 8 was added to this edition and is specifically dedicated to this topic.

This full-color text of clinical photographs and photomicrographs enhances the transference of didactic knowledge into clinical application. The depth and scope of the text information is presented in a clear, succinct manner that is
understandable, provides appropriate information to the dental hygiene student, and is a useful reference to the practitioner. An oral pathologist who used the text to teach dental hygiene courses reports that specific features make this text teacher- and student-friendly. These features include the detailed objectives and vocabulary at the start of each chapter, review questions at the end of each chapter with corresponding answers at the end of the book, a comprehensive and valued synopsis of the chapter information at the end of each chapter, and a text glossary. All were a definite asset to the learner and to the teacher of the course, who also comments that the CD-ROM was a prized resource. The students appreciated having the images for study on the computer and in the text.

The quality contrast and density of the radiographs clearly depict abnormalities and pathologies of which the clinician must be knowledgeable. Throughout the chapters, accurate references are made to figures that correspond to the text. For example, Langerhans cell disease is clearly depicted histologically, radiographically, and clinically. Illustrations enhance the clarity of the information and are included as appropriate throughout the chapter readings.

This colorful textbook with corresponding CD-ROM definitely meets its goal to be an excellent oral pathology text for dental hygiene students, practitioners, and teachers. It is practical, user-friendly, and comprehensive. Thank you to the authors and their contributors for their excellent efforts in making such a useful text for dental hygiene professionals.
In neatly organized chapters, this volume of the Quintessential Dental Practice series clearly states the facts about, and the needs and ideas for improvements of, the oral health of children in the United Kingdom. Although much of the information differs from the United States, the topic of pediatric cariology is covered, from understanding the need to techniques used in preventing and managing caries in children. The photos are clear and the illustrations complement the text. Although there are some slight spelling or word differences, the meanings are understood by the context. This volume mentions state-of-the-art technology such as the Diagnodent lasers and fiber optics to detect caries. It briefly includes lasers, air abrasion, and ozone technology in management of caries. The references and suggestions for further reading
are relatively current, from the past 3 to 10 years. This volume has many topics and facts appropriate for dental hygienists
to refresh their knowledge and gain understanding of oral health issues in children, although there are several chapters
that share clinical details for dentists, making this volume inappropriate for patients.

Pediatric dentistry in the United States does have its differences in many aspects from the United Kingdom. The most
significant difference is that many parts of the United Kingdom have the highest prevalence of dental caries, whereas in
the United States, which has used preventable measures for years, especially fluoridated water, dental caries are almost
completely preventable. Many dental practitioners in Western Europe treat pediatric toothaches by removing the tooth,
which creates another issue to deal with when a space is left. Due to socioeconomic conditions in the United Kingdom,
saving the tooth may not be an option, as this book explains.

The book uses the International Dental Federation (FDI) tooth numbering system, which is also called the International.
This system is two-digit, by numbering the quadrants 1-4, and numbering the teeth 1-8. In the United States, the Universal
Tooth Numbering System is used, which numbers the teeth from 1 to 32 for adults and A to T for children. Chapter 4
mentions a caries prevention toolkit for children and recommends Xylitol chewing gum, chlorhexidine, and fluoride
varnish, along with diet modification and sealants. The United States is just now experiencing the use of Xylitol; it can
be found in health food stores in the form of gum, mints, or packets, and in Trident chewing gum. Xylitol is a 5-carbon
sugar alcohol that is not fermentable by oral bacteria and inhibits Streptococcus mutans. In the United States, chlorhexidine
is more regularly prescribed for adults than children as an adjunct to tissue management in patients with periodontal disease.
In the United States, the Food and Drug Administration has approved fluoride varnish as a "cavity liner" and a desensitizing
agent. Its use as a dental caries preventive agent is considered "off label." Fluoride varnish has a long history of use
throughout Europe, Canada, and the Scandinavian countries since the 1980s.

Chapters 5 through 8 contain techniques used by dentists in both the United Kingdom and the United States. There are
some techniques that American dentists may find interesting in dealing with the child patient. Chapter 5 mentions the
Atraumatic Restorative Treatment (ART) technique, which treats decay as early as possible by using only hand instruments
for excavating and a finger to condense glass-ionomer cement for fillings. In the United States, the ART technique used
widely is air abrasion microdentistry, which treats decay as early as possible with a gentle spray of air and powder mix
that removes decay with no needle or drill, and fills it with a tooth-colored resin. Chapter 7 promotes pulp therapy as an
alternative to extracting decayed teeth in the primary dentition. The introduction mentions the recent controversy and
changes on the use of formaldehyde in humans for pulp therapy by the International Agency for Research on Cancer,
which confirms the carcinogenic effects of formaldehyde in humans and promotes aldehyde-free techniques in the United
Kingdom. They are currently using ferric-sulfate instead of formocresol. Chapter 8 describes a technique called "discing"
that the United Kingdom also uses. This technique is used to reduce recurrent caries in primary teeth by removing
interproximal caries with abrasive discs. This reshapes the teeth to produce easier access for cleansing, although the results
are not aesthetically pleasing, as the chapter describes.

As a dental hygienist, I found this volume in the Quintessential Series informative and interesting. It expanded my view
of children's oral health concerns and access to care in countries other than my own and reminded me of my role as an
oral health educator, which was stressed by my instructors in dental hygiene school. I would recommend this volume to
dentists, dental hygienists, and dental assistants.
Spanish for Dental Professionals - A Step by Step Handbook

Judy Campbell Karpis

Reviewed by Judy Campbell Karpis, RDH, EdD.

Spanish for Dental Professionals - A Step by Step Handbook

Bender D, Maier M, Stern I

University of New Mexico Press, 2005

Albuquerque, New Mexico

107 pages, illustrated, CD-ROM


$21.95

"You can't judge a book by its cover" comes to mind when reading over Spanish for Dental Professionals - A Step by Step Handbook. It depends upon what your level of understanding of Spanish is and what your expectations are when reading this book for personal and/or professional reasons. If you are an absolute beginner and have very little understanding of the Spanish language, then perhaps this book is for you. If you are, however, a seasoned resident of a bilingual community, a 100-page book will not compensate for years of missed language skills.

What the writer of this book attempts to do is to teach conversational Spanish in the context of one paperback book and CD-ROM, something that I haven't been able to learn completely through years of practice, coursework, and living fully immersed in a predominantly Spanish speaking culture.
The book starts out very logically, explaining that it should be used by small groups of learners who want to work together to improve their dental health-related spoken Spanish skills. Further explained is that there should be a "facilitator," not a teacher, who has the best Spanish language skills of the group. It turns out by reading on, that the book is not really "Spanish for Dental Professionals", but learning to speak Spanish FOR dental professionals who want to learn conversational Spanish.

As described in the book, the authors urge the group of learners to meet once a week at lunch. Also listed in the suggestions for the learner are some excellent adjunctive activities, such as visiting a grocery store, restaurant, or church service where Spanish is spoken. Also recommended by the writers is for the learner to "build a personal library of Spanish resources." This suggestion confirms what eventually became evident to me, this book cannot stand on its own as a means of learning dental Spanish or conversational Spanish.

While the book is technically and factually correct, it may not cover some of the important sayings that are used by various groups of Spanish speaking individuals in the different parts of the United States.

The authors clearly and adequately cover the topics included in the book. The accompanying CD also adds much needed information. However, it is not a reference book, as indicated by the description on the cover. One major flaw is that there is no comprehensive chart of dental terms for dental hygienists. Also, the cover states that the book/CD are meant to be part of a one hour per week, six week long training course. Without additional resources, it is unrealistic to expect to enhance conversational Spanish skills in that period of time.

Herein lies the problem. For instance, on page 17, there is a chart listing "New Expressions" or Expresiones nuevas: Aprendiendo sobre la familia (Learning about the Family). The chart contains very useful information about how to ask the patient their name, their mother's name, etc. This is all fine and well if the patient answers you in one word sentences and doesn't elaborate. However, if the patient says back to you, "Me llamo Jose; mis amigos llama me Gordo," you may just be in trouble. You might find yourself smiling and shaking your head and wondering what the heck they just said. 'Ok, I got the part about "My name is Jose, but what else did he say?"

Again, on page 21, there is a wonderful chart which tells the dental professional basic sayings that you might want to say to the patient on the first visit. "Abra la boca, por favor" is a good one, for example, if you just need the patient to open their mouth. "Saque la lengua" is great if you are doing a cancer screening and need them to stick out their tongue. Unfortunately, if they talk back in their native language, you will have a difficult time understanding what they are saying.

The level of writing is appropriate for all levels of readers, especially for college-educated dental hygienists. The photos and illustrations complement the text, especially the charts. The flash cards at the end of the book are a "must" for anyone who takes on the basics of Spanish.

The book includes very important information, such as the months and seasons, as well as the numbers in Spanish. Included in the book, however, is a "Immigrant Experience Game" which seems somewhat out of place. During the game, the players can get their work visa revoked, get deported, arrive via JFK or earn their GED - none of which has to do with Spanish for the dental professional.

One of the other game pieces says, "You must speak fluent English," and that one makes me almost laugh out loud. Here in South Florida, it is we Americans that must speak fluent Spanish. Spanish has become part of our culture. In order to work here, you MUST speak Spanish fluently. It is not always the other way around. It is not unusual in Miami and Miami Dade County, especially, to walk into a business and not have ANYBODY speak English. This makes the struggle for us to learn perfect Spanish even more immediate and important.

What parts stand out as far as the book is concerned? The CD-ROM is an excellent adjunct to the book and the flash cards in the back of the book are good for memory exercises.

The book does succeed in its goal to "be used in emergency situations or as a source of phrases to make routine visits more comfortable for patients." As far as meeting its stated goal, "to help dentists, dental hygienists, and other dental personnel communicate with Spanish-speaking patients," that may be a stretch for this book alone.
Comparison of Muscle Activity Associated with Structural Differences in Dental Hygiene Mirrors

Melanie Simmer-Beck, Kimberly K Bray, Bonnie Branson, Alan Glaros and Jeff Weeks

Purpose. Ergonomic studies suggest that the commonly used pinch grasp, held in a static position, is a contributing factor for dental Hygienists' development of work-related musculoskeletal disorders (WMSDs) such as carpal tunnel syndrome (CTS), Trigger Thumb, de Quervain's stenosing tenosynovitis, and carpometacarpal (CMC) osteoarthritis. The pinch grasp is commonly used by the dental hygienist while holding the dental mirror in the non-dominant hand. In response to this concern, manufacturers are redesigning dental mirror handles. The value of these re-designed products is based solely on anecdotal evidence. To date, minimal research has been done to examine the non-dominant mirror hand. The purpose of this study was to objectively evaluate dental mirror handle design using surface electromyography (sEMG) to compare muscle activity associated with grasping the mirror.

Methods. This randomized controlled clinical trial utilized a two-by-two repeated measures statistical design. Data was collected on a convenience sample of 19 (N=19) healthy dental hygiene students in their last year of study. Data collection was divided into two phases to maintain a balanced study. The independent variables in phase I were diameter and weight. The independent variables in phase II were weight and padding. Muscle activity was measured while grasping various dental hygiene mirrors in 30-second increments using sEMG. Following data collection subjects designated which mirror felt most and least comfortable to compare subjective data with objective data.

Results. Three statistically significant results occurred. In phase II, padding (p=.01) demonstrated the largest reduction of muscle activity in the flexor pollicis brevis, by decreasing mean muscle activity by 3.7 μV. The interaction of diameter and weight (p=.01) in phase I reduced the mean muscle activity in the extensor digitorum by .8 μV and weight (p=.02) in phase II decreased the muscle activity in the extensor digitorum by .62 μV. Self-reports of comfort reported by the subjects in this study were not consistent with the measurements of muscle activity using sEMG.

Conclusion. Ergonomic adaptations to dental hygiene mirror handles were associated with increases and decreases in muscle activity. The clinical impact of this is amplified as force is exerted. Furthermore, it may be possible to reduce WMSDs for dental hygienists by using instrument designs during the workday. Self-reports of comfort by the subjects in this study did not calibrate with the measurements of muscle activity using sEMG. Additional research is needed to further isolate the external variables of the study and to determine what actual reduction in muscle activity is significant for maintaining musculoskeletal health.
Keywords: musculoskeletal disorders, ergonomics, instrumentation, mirrors, dental hygiene

Introduction

The occurrence of work-related musculoskeletal disorders (WMSDs) in dental hygiene is an occupational concern. Lalumandier and McPhee estimated that 75% of dental hygienists experience hand problems and 56% have classic symptoms of carpal tunnel syndrome (CTS). Data from the Bureau of Labor and Statistics and the US Department of Labor revealed findings consistent with these. Numerous studies estimate the prevalence of this problem; however, minimal research exists about the response and interaction of muscles when integrating ergonomic solutions.

WMSDs result in a loss of income, increase in medical expenses, increase in workman's compensation claims, and often result in higher levels of difficulty completing daily tasks. They frequently require days off work, permanently decreasing the number of days worked, or ultimately a change in career. As a result of findings such as these, prevention of musculoskeletal disorders has become a priority for dental hygienists. Many ergonomic devices have been developed and marketed to the dental community to increase the longevity of dental hygiene careers. The value of these devices is largely based on practitioner perception by self-reports and focus groups. Spielholz et al evaluated three common methods of ergonomic assessment simultaneously: self report, video analyses, and direct measurement using indwelling EMG. Inter-method comparisons between extreme posture, repetition, and force and movement velocity were assessed in 18 subjects while processing tree seedlings. Self-reports were the least precise method of measurement when examining musculoskeletal disorders. The authors concluded that grip force was best quantified by direct measurement using EMG.

Common workplace risk factors contributing to WMSDs is the use of the pinch grasp to hold the instrument while applying pressing with the finger tips. Studies using physiological measurements noted increased pressure within the carpal tunnel when a pinch grasp was used when applying pressure. Biomechanical model predictions and tissue studies of exertion involving pinch grasp demonstrated an increase in the finger flexor tendons when pressure was applied. Static biomechanical models developed at Mayo Clinic and at University of Michigan have been used to estimate tension in the finger flexor tendons during various work tasks. Results concluded that when a normal load is applied to the palmer side of the fingers while pinching, mechanical movements are created at the wrist and finger joints. The tensile force to oppose these movements is much higher than the normal force acting on the fingers when normal force is exerted with only the finger tips. Pinch grasp is used for both the mirror hand and the scaling hand. It has been calculated that one pound of pinch between the thumb and index finger will produce six-to-nine pounds of pressure at the basal joint of the thumb. In order to minimize the effect of the pinch grasp and to create a neutral position, it is recommended that dental instruments and dental mirror handles have a large diameter, be lightweight, and be padded.

The current literature provides only anecdotal reports that study the effectiveness of diameter, weight, and padding of handles on reducing WMSDs. The purpose of this study was to use sEMG to objectively compare muscle activity associated with common structural differences in dental hygiene mirrors while applying simulated dental hygiene procedures. Furthermore, the intention of this study was to allow investigators to examine the interaction of three muscles in the hand and forearm when the pinch grasp is used. Phase I involved testing the effects of diameter and weight. Phase II involved testing the effects of weight and padding.

Review of the Literature

Work-related musculoskeletal disorders (WMSDs) can be acute and/or chronic, and are often a consequence of practicing clinical dental hygiene over time. The most frequently reported altered sensations include pain, tingling, and numbness in the hands due to the physical stress of performing dental hygiene procedures. Reported hand problems, such as carpal tunnel syndrome (CTS), are consistently higher in the dental hygiene population than in the general population.
Instrumentation affects a large portion of the modifiable WMSD risk factors. Problems associated with instrumentation include: forceful exertions, repetition, small diameter instrument handles, flexion and extension of wrists, pinch forces, static loading of the fingers and hands, awkward hand postures, and other prehensile motions.\textsuperscript{15,18,19} Intervention methods include alternating instrument handle sizes, using instruments with larger diameter handles, using lightweight instruments, and using instruments with rubber coating or padding.

There is a distinct difference between the instrumentation techniques of the scaling hand and the mirror hand. The non-dominant hand of the dental hygienist is used for holding the mirror to gain better field visualization and for retracting the tongue and cheek. Unlike the dominant hand, which performs multiple tasks in a variety of positions to complete the scaling procedures, the non-dominant hand remains in a static position and often requires a forceful grip in order to retract the tongue and cheek throughout most of the dental hygiene appointment,\textsuperscript{15} which results in decreased circulation of blood and oxygen and increases the risk of developing a WMSD.\textsuperscript{19} To date, no research has addressed this problem.

In a descriptive study by Horstman\textsuperscript{15} dental hygienists were videotaped and observed during a normal workday. Using time and motion analyses, the investigators concluded that the non-dominant hand was in a static posture of wrist flexion while holding the patient's mouth open, and that it did not engage in wrist flexion and extension.\textsuperscript{15} In an epidemiological study using indwelling electromyography (EMG) to examine female dentists performing authentic dental work, Akkeson et al documented more static work in the mirror hand than in the working hand. A combination of extreme palmer flexion and ulnar deviation in the mirror hand was also noted.\textsuperscript{19}

Experimental and epidemiological research acknowledges the origin of a WMSD as multifactorial.\textsuperscript{20} A conceptual framework for developing a WMSD has been completed by the National Research Council. In this model, the work environment, organizational factors, and social context are influenced by physical and psychological factors as well as non-work-related activities.\textsuperscript{20}

Work environment preventive strategies for all upper extremity disorders are similar and suggest creating neutral environments for the hand, wrist, and thumbs.\textsuperscript{9,21,22} In the landmark study, "The Biocentric Technique: A Guide to Avoiding Occupational Pain," Meador\textsuperscript{22} defines a neutral wrist position as the "forearm and hand are in the same horizontal plane."\textsuperscript{22} He advocates neutral positioning during dental hygiene instrumentation and shifting the workload of the muscles from the small muscle groups to the large muscle groups.\textsuperscript{22}

The objective of ergonomics is to fit the job to the worker.\textsuperscript{17} Ergonomic experts in the dental field have made recommendations for instrumentation modification and selection. These recommendations include decreasing hand forces during instrumentation and improving wrist posture.\textsuperscript{18} Suggested instrument variations include increasing the diameter, choosing instruments that are lightweight and balanced, padding the instruments, adapting the shape of the handle and texture, and varying the sizes.\textsuperscript{17,23,24}

The utilization of surface electromyography (sEMG) allows the observer to objectively calculate the energy of the muscles. It is safe, easy, noninvasive, and frequently used to evaluate muscle responses to stimuli. When utilizing multiple sensors, it is possible to differentiate how different aspects of the muscles accomplish various tasks.\textsuperscript{25} The basis of the sEMG signal is motor unit action potential. This is measured in microvolts (μV). At rest, this measurement is usually around 2 μV. At work, the muscles begin to contract and the measurement can increase up to approximately 200 μV.\textsuperscript{25}

A common limitation of sEMG is the possibility of crosstalk error, which makes isolating the sEMG recordings to a specific muscle difficult.\textsuperscript{25,26} Utilization of sEMG requires calibration of equipment and analyses and knowledge of muscle anatomy to prevent crosstalk error.\textsuperscript{26} Another shortcoming of sEMG is the complexity of the anatomy being studied. The motor neuron pool is comprised of signals from the brain, joints, and other muscles. Nerves transmit these signals. Neurotransmitters and biochemicals can affect the signal.\textsuperscript{27} Basmajian and DeLuca\textsuperscript{27} suggested the sEMG signal indicates the status of the muscle and the status of the nervous system around the muscle.
To date, no empirical evidence exists to support that instrument modification and selection recommendations will decrease the occurrence of WMSDs. Numerous studies have suggested the need of further research.\textsuperscript{8,15,19,23,24} Results of a study by Spielholz et al indicated that self-reports were the least precise method of measurement.\textsuperscript{8} Quantification by direct measurement, such as that of sEMG, would more accurately measure grip forces\textsuperscript{8, 24} and allow dental hygienists to make more informed decisions. It has been recommended that quantification needs to be evaluated in both the scaling hand and the mirror hand.\textsuperscript{19} A non-subjective approach to data collection is necessary in order to accurately assess the ergonomic effect of dental hygiene products. The sEMG technique allows the observer to view the muscle at rest and at work and to objectively quantify the energy of the muscle. When utilizing multiple sensors, it is possible to differentiate how different aspects of the muscles accomplish various tasks, and how the muscles interact with each other (25).

**Statement of the Problem**

The purpose of this study was to use sEMG for comparison of muscle activity associated with structural differences in dental mirrors when applying simulated dental hygiene positioning. Phase I involved testing the following null hypotheses:

1. The diameter of dental mirror handles will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.
2. The weight of dental mirrors will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.
3. The interaction effect of diameter and weight will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.

Phase II involved testing the following null hypotheses:

1. The weight of dental mirrors will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.
2. The padding of dental mirror handles will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.
3. The interaction effect of weight and padding will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.

**Material and Methods**

The Sample Power (version 2.0) program (SPSS, Inc., Chicago, IL) was used to estimate sample size. Data (means and standard deviations) from a pilot study were used to estimate effect size, alpha was set to 0.05, and power was set to 0.80. After entering these data into the program, we determined that a sample size of 10 subjects would provide sufficient power to detect statistically significant differences in electromyography (EMG) activity while gripping mirror handles of different sizes and cushioning.

The target population for the study comprised of 28 (N=28) female dental hygiene students in their final semester of study at the University of Missouri-Kansas City School of Dentistry. A convenience sample of nineteen (N=19) students volunteered to participate and met the inclusion criteria. Two students chose to participate but did not meet the inclusion criteria to participate. Seven students were not interested in participating.

Inclusion criteria included no significant history or evidence of musculoskeletal disorders within the last 30 days. The musculoskeletal disorder (MSD) criteria used by Lalumandier and McPhee\textsuperscript{1} were adopted as inclusion criteria. This information was obtained through completion of the subject assessment form. Subjects reporting a diagnosis of carpal tunnel syndrome (CTS), history of hand surgery, or answering yes to three or more of the symptoms of past MSDs on the
subject assessment form were excluded from the study. This was planned to control for external variables influencing the outcomes.

Demographics, medical conditions frequently related to the development of CTS, and anthropometric characteristics were also obtained to describe each subject. The same subjects participated in both phase I and phase II. Table I displays the means (± SD) and the range of demographics and relevant characteristics of the sample with respect to musculoskeletal factors. Overall this was a very homogenous sample. The sample exhibited a wide distribution of non-modifiable risk factors such as ages and weights; however, length, breadth, grip diameters, and grip strengths of the sample were all very similar. Nine of the subjects had prior dental experience and eight subjects reported one or two symptoms of MSDs within the last 30 days.

Table I. Characteristics of Subject Sample

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Range</th>
<th>Mean (± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21-44 years</td>
<td>25.31 (5.7) years</td>
</tr>
<tr>
<td>Weight</td>
<td>104-218 lbs.</td>
<td>129.1 (25.3) lbs.</td>
</tr>
<tr>
<td>Hand Length</td>
<td>160-190 mm.</td>
<td>177.9 (6.8) mm.</td>
</tr>
<tr>
<td>Handbreadth</td>
<td>81-101 mm.</td>
<td>91.4 (5.8) mm.</td>
</tr>
<tr>
<td>Grip Diameter</td>
<td>152-190 mm.</td>
<td>175.7 (8.3) mm.</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>45-79 ft. lbs.</td>
<td>62.6 (10.0) ft. lbs.</td>
</tr>
<tr>
<td>Years of Experience</td>
<td>0-5 years</td>
<td>1.42 (1.8) years</td>
</tr>
</tbody>
</table>

All subjects gave informed consent to participate in the study and signed the appropriate forms. Confidentiality was protected by assigning each subject a number. This study was approved by the Adult Social Science Institutional Review Board at the University of Missouri-Kansas City.

The design of this study for phase I and phase II was a two-factor, repeated measures statistical design. The within-subject approach examined the relationship of dental mirror handle diameter, weight, and padding as it related to muscle activity during simulated dental hygiene positions. The blue arrow brackets in Figure 1 display the mirror handles used to collect data when evaluating the independent variables, diameter and weight, during phase I of the study. The red arrow brackets in Figure 1 display the mirror handles used to collect data when evaluating the independent variables, weight and padding, during phase II of the study. This was necessary to keep the design balanced due to the inability to place padding on the large diameter mirror handles. Data was collected in two phases over a period of 30 days. A minimum of 24 hours of rest was required between collection of phase I and phase II data.
For each phase, under identical testing conditions, participants were asked to grasp mirror handles two times, according to the mirror sequence assignment, in order to assess consistency of grasping technique within each individual. The second round of testing occurred in the reverse order of the first. Motor unit action potential (MUAP), commonly referred to as muscle activity, was measured in μV, using the Noraxon® sEMG apparatus. Reliability was assessed using Pearson product moment correlation coefficient, significant at the 0.01 level (2-tailed), for each mirror handle within each muscle group. The coefficients for phase I ranged from 0.69 to 0.98. The coefficients for phase II ranged from 0.63 to 0.96. Based on the internal consistency of the sEMG readings, a mean score was completed for each mirror within each muscle group for each subject. The average score was computed to represent a single measure of muscle activity. This mean score was used for statistical analyses.

Dental hygiene positioning was reproduced through a simulated dental hygiene clinic. A dentoform mounted on a pole was placed in a standard patient chair in a supine position. The clinician sat on a standard operator stool.

Miniature, circular Noraxon® 2 cm diameter, dual silver-chloride surface electrodes were used to collect sEMG data from each muscle group. Figure 2 displays the bipolar sensor configuration recommended by Hermens et al. A single, circular Noraxon®, 4 cm diameter, surface electrode was placed on the dorsal side of the wrist and used as a ground. All electrodes were pre-gelled. All surface sites were cleansed with alcohol on gauze pads prior to electrode placement.
The electrodes were connected to electromyography (EMG) Module MyoSystem1200. The fullwave rectified outputs from the modules were fed into a Toshiba® laptop satellite computer. Figure 3 displays the three channels used to delineate MUAP (muscle activity) between each of the three muscles being measured. The computer interface converted the analogue signals to digital form. The operation of the interface was controlled by MyoResearch XP software.

Figure 2. Bipolar sensor electrode configuration, used with a single circular electrode placed on the dorsal side of the wrist. The electrode on the upper right is on the extensor digitorum, the electrode under the glove is on the flexor pollicis brevis, and the electrode on the upper left is on the flexor digitorum superficialis. The electrode directly above the glove is the ground.

Figure 3. Noraxon sEMG signals converted analogue signals to digital form displaying motor unit action potential for the extensor digitorum, flexor pollicis brevis, and flexor digitorum superficialis.
Surface electrodes were placed on the extensor digitorum, flexor pollicis brevis, and flexor digitorum superficialis by an experienced, licensed occupational therapist to determine correct muscle identification and electrode placement. An occupational therapist was chosen for muscle identification and electrode placement due to their skilled background of human anatomy and neuroanatomy. The same occupational therapist was used throughout the data collection to ensure intra-rater reliability. All surface electrodes were placed according to sEMG sensors and sensor placement recommendations developed at the European concerted action SENIAM (surface EMG for a non-invasive assessment of muscles).

Surface electrodes were placed on the extensor digitorum muscle group by palpating the middle of the forearm approximately three quarters of the distance between the elbow and the wrist while having the subject extend her fingers. The inter-electrode distance was 2 cm. The sensors were placed in the distal part of this muscle between the innervation zone and the end zone. The orientation of the electrodes was parallel to the muscle fibers of the extensor digitorum. Once electrodes were placed, subjects were requested to extend their thumb in order to ascertain that the correct muscle was being evaluated.

Surface electrodes were placed on the flexor pollicis brevis muscle group by palpating the medial aspect of the thenar eminence while the subject flexed her thumb. The sensors were placed in the distal part of this muscle between the innervation zone and the end zone. The orientation of the electrodes was parallel to the muscle fibers of the flexor pollicis brevis muscle group. The inter-electrode distance was 2 cm. Once electrodes were placed, subjects were requested to abduct their thumb in order to ascertain that the correct muscle was being evaluated.

Surface electrodes were placed on the flexor digitorum superficialis muscle group by palpating approximately three quarters of the distance from the elbow to the wrist on the ventral side of the middle of the forearm while having the wrist supported. The inter-electrode distance was 2 cm. The sensors were placed in the distal part of this muscle between the innervation zone and the end zone. The orientation of the electrodes was parallel to the muscle fibers of the flexor pollicis brevis muscle. Once electrodes were placed, subjects were requested to make a fist and flex their wrist in order to ascertain that the correct muscle was being evaluated.

Signals from the sEMG apparatus that appear equally, and on two electrode conductors at the same time, are considered common mode disturbance, commonly referred to as noise. Noise is seen with respect to a system's ground reference point. A single reference electrode was placed on the dorsal side of the wrist where the tissue was electrically inactive. This minimized risk for common mode disturbance. The three muscle groups were studied simultaneously.

A predetermined, stratified mirror sequence was placed in separate envelopes and randomly assigned to each subject for both phases of the study. This ensured mirror order was balanced. The envelope was given to the investigator at the time of data collection.

Subjects were placed in a neutral operator position as defined by Nield. Subjects had their arms at waist level, feet flat on the floor, thighs parallel to the floor, back at a 100-degree angle to the chair, head erect, and body evenly distributed. The typodont was open in a chin-up position. Subjects were required to sit in the 12:00 operator position and instructed to look down into the typodont's mouth as displayed in Figure 4. Subjects used a modified pen grasp in a gloved hand to pinch grasp the dental mirror while examining the lingual surface of the typodont model's maxillary anterior teeth in the mirror's reflection. Subjects were instructed to hold this posture for 30 seconds in order to create a static environment. The subjects had a minimum of 30 seconds of rest between each testing. Figure 5 displays subject stretching and changing positions in order to reach the required minimum resting threshold of 2.0 μV preceding taking measurements. The principle investigator instructed the subjects to stop and resume the pinching task as indicated by the sEMG timer and minimum threshold measurements.
Quantitative data obtained from the MyoResearch XP software were coded and entered into the Statistical Package of Social Science (SPSS) 12.0. RM ANOVA ($p \leq 0.05$) and appropriate descriptive statistics including frequency distributions and central tendencies were computed for both main and interaction effects. Two factors were measured in phase I (factor 1= thin and thick, factor 2=heavy and light). Two factors were measured in phase II (factor 1= heavy and light, factor 2=unpadded and padded). An estimation of effect size was determined by calculating partial eta squared, a standardized technique for this purpose.³⁰
Results

Table II displays mean (± SD) values of muscle activity for the three muscles under each condition for phase I. Repeated measures (RM) ANOVA (p≤ 0.05) was applied to evaluate main and interaction effects. Individual means are reported for each mirror handle and the marginal means are reported to help interpret the main effects. Results show a statistically significant (p=.01, η²=0.29) interaction of diameter and weight affecting muscle activity in the extensor digitorum. This result is further supported by the partial eta-squared statistically associated with this effect.30 A greater level of muscle activity was present with the thin plastic handle, and the opposite effect occurred with the thick plastic handle. The main effects of diameter (p=.14, η²=.12) and weight (p=.58, η²=.02) were not determined to be statistically significant; however, the partial eta-squared indicates diameter had a low to moderate effect on muscle load during testing activities.30

<table>
<thead>
<tr>
<th></th>
<th>Extensor Digitorum</th>
<th>Flexor Pollicis Brevis</th>
<th>Flexor Digitorum Superficialis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wide Diameter</td>
<td>Thin Diameter</td>
<td>Marginal Means</td>
</tr>
<tr>
<td>Plastic (Light)</td>
<td>12.5 (4.6)*</td>
<td>13.8 (4.9)*</td>
<td>13.2 (4.8)</td>
</tr>
<tr>
<td>Metal (Heavy)</td>
<td>13.4 (5.6)*</td>
<td>13.3 (5.4)*</td>
<td>13.4 (5.5)</td>
</tr>
<tr>
<td>Marginal Means</td>
<td>13.0 (5.1)</td>
<td>13.6 (5.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexor Pollicis Brevis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic (Light)</td>
<td>40.9 (32.1)</td>
<td>39.7 (30.9)</td>
<td>40.3 (31.5)</td>
</tr>
<tr>
<td>Metal (Heavy)</td>
<td>41.8 (31.2)</td>
<td>41.8 (31.1)</td>
<td>41.8 (31.2)</td>
</tr>
<tr>
<td>Marginal Means</td>
<td>41.3 (31.7)</td>
<td>40.7 (31.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexor Digitorum Superficialis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic (Light)</td>
<td>13.0 (8.7)</td>
<td>13.0 (9.4)</td>
<td>13.0 (9.1)</td>
</tr>
<tr>
<td>Metal (Heavy)</td>
<td>14.1 (8.5)</td>
<td>13.5 (8.9)</td>
<td>13.8 (8.7)</td>
</tr>
<tr>
<td>Marginal Means</td>
<td>13.5 (8.6)</td>
<td>13.2 (9.0)</td>
<td></td>
</tr>
</tbody>
</table>

* Indicates statistically significant interaction effect of weight and diameter.

For the flexor pollicis brevis, the interaction effect of diameter and weight (p=.53, η²=.02), and the main effects of diameter (p=.36, η²=.05) and weight (p=.17, η²=.10) were not statistically significant. For the flexor digitorum superficialis, the interaction effect of diameter and weight (p=.48, η²=.03), and the main effects of diameter (p=.53, η²=.02) and weight (p=.10, η²=.14), were not statistically significant.

Due to the following phase I results, we reject the following null hypothesis: There will be no interaction effect of diameter and weight that will produce significant differences in muscle activity when applying simulated dental hygiene procedures. We favor the following hypothesis: The interaction of diameter and weight will produce significant differences in muscle activity when applying simulated dental hygiene procedures. We failed to reject the following null hypothesis: The diameter of dental mirror handles will produce no significant differences in muscle activity when applying simulated dental hygiene procedures and the weight of dental mirrors will produce no significant differences in muscle activity when applying simulated dental hygiene procedures.

After phase I testing, the subjects delineated which mirror handle provided the most comfort and the least comfort. Table III displays the percentage of mirror preferences delineated by each subject. Individual's subjective assessment of comfort was also compared to their muscle activity to evaluate accuracy of each subject's preference. Forty-two percent of the subjects accurately identified which mirror was most comfortable within the extensor digitorum and the flexor digitorum superficialis. Thirty-two percent of the subjects accurately identified which mirror was most comfortable within the flexor pollicis brevis. Eighteen percent of the subjects accurately identified which mirror was least comfortable within the extensor digitorum. Thirty-two percent of the subjects accurately identified which mirror was least comfortable within the flexor pollicis brevis. Twenty-six percent of the subjects accurately identified which mirror was least comfortable within the flexor digitorum superficialis.
Table IV displays mean (± SD) values for electromyography for the three muscles under each condition for phase II. Repeated measures (RM) ANOVA (p ≤ 0.05) was applied to evaluate main and interaction effects. Individual means are reported for each mirror handle and the marginal means are reported to help interpret the main effects. Results show that weight (p = .02, $\eta^2 = 0.27$) had a statistically significant effect on muscle activity in the extensor digitorum with an associated partial eta-squared supporting this conclusion. The main effect of padding (p = .60, $\eta^2 = 0.02$), and the interaction effect of weight and padding (p = .39, $\eta^2 = 0.04$) were not significant.

In the flexor pollicis brevis, results illustrate the main effect of padding had a statistically significant effect (p = .01, $\eta^2 = .30$) on muscle activity while grasping mirror handles. Results for the main effect of weight (p = .34, $\eta^2 = .05$), and the interaction effect of weight and padding (p = .22, $\eta^2 = .08$) were not statistically significant.

The flexor digitorum superficialis had an interaction effect of diameter and weight (p = .53, $\eta^2 = .02$) that was not statistically significant. The main effects of weight (p = .90, $\eta^2 = .001$) and padding (p = .88, $\eta^2 = .001$) were not statistically significant.
Due to the following phase II results, we reject the following null hypotheses: The weight of dental mirrors will produce no significant differences in muscle activity when applying simulated dental hygiene procedures and the padding of dental mirror handles will produce no significant differences in muscle activity when applying simulated dental hygiene procedures. We favor the following hypotheses: The weight of dental mirrors will produce significant differences in muscle activity when applying simulated dental hygiene procedures and the padding of dental mirror handles will produce significant differences in muscle activity when applying simulated dental hygiene procedures. We failed to reject the following null hypothesis: There will be no interaction effect of weight and padding that will produce significant differences in muscle activity when applying simulated dental hygiene procedures.

After phase II testing, the subjects delineated which mirror handle provided the most comfort and the least comfort. Table V displays the percentage of preferences delineated by each subject. Individual's subjective assessment of comfort was also compared to their muscle activity to evaluate accuracy of each subject's preference. Twenty-one percent of the subjects accurately identified which mirror was most comfortable within the extensor digitorum and the flexor pollicis brevis. Thirty-two percent of the subjects accurately identified which mirror was most comfortable within the flexor digitorum superficialis. Five percent of the subjects accurately identified which mirror was least comfortable within the extensor digitorum. Sixteen percent of the subjects accurately identified which mirror was least comfortable within the flexor pollicis brevis. Twenty-six percent of the subjects accurately identified which mirror was least comfortable within the flexor digitorum superficialis.

### Table V. Subject Designation of Mirror Preferences for Phase II

<table>
<thead>
<tr>
<th>% Reporting Most Comfortable</th>
<th>Non-padded Handle Means</th>
<th>Padded Handle Means</th>
<th>Overall Weight Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic (Light)</td>
<td>10.5%</td>
<td>53%</td>
<td>63.5%*</td>
</tr>
<tr>
<td>Metal (Heavy)</td>
<td>5%</td>
<td>31.5%</td>
<td>36.5%*</td>
</tr>
<tr>
<td>Overall Padding Preference</td>
<td>15.5%**</td>
<td>84.5%**</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% Reporting Most Discomfort</th>
<th>Plastic (Light)</th>
<th>Metal (Heavy)</th>
<th>Overall Padding Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31.5%</td>
<td>42%</td>
<td>73.5%**</td>
</tr>
<tr>
<td>Overall Rating</td>
<td>16%</td>
<td>10.5%</td>
<td>26.5%**</td>
</tr>
</tbody>
</table>

*Weight had a statistically significant main effect on muscle activity within the extensor digitorum.

**Padding had a statistically significant main effect on muscle activity within the flexor pollicis brevis.

### Discussion

#### Clinical Relevance

Unfortunately, research is not available that delineates how much muscle activity equates to the development of a work-related musculoskeletal disorder (WMSD), so the direct application of the data gathered in this study is narrow. The largest statistically significant reduction of muscle activity occurred during phase II of this study, in one of the largest muscles of the thumb, the flexor pollicis brevis. Padding reduced mean muscle activity by 3.7 μV. In phase I, the interaction of diameter and weight decreased the muscle activity in the extensor digitorum by 1.3 μV and in phase II, weight decreased the muscle activity in the extensor digitorum by .62 μV. Research indicates that muscle activity ranges from a resting state...
of 0-2 μV, and can reach as high as 200 μV. It is difficult to ascertain if these rather small decreases in muscle activity would result in promoting musculoskeletal health.

When comparing the subjective data to the objective data in phase I, 68% of the subjects surmised the thick plastic mirror handles were the most comfortable. This is consistent with the mean muscle activity and the statistically significant interaction of diameter and weight within the extensor digitorum. Seventy-four percent of the subjects identified the thin metal mirrors were least comfortable. This calibrated with having the highest mean muscle activity in the extensor digitorum, however, it is inconsistent with the findings of the other muscle groups. Seventy-four percent of the subjects surmised the plastic handles were the most comfortable. Fifty-three percent of the subjects identified metal handles were the least comfortable. This is consistent with the statistically significant main effects of weight within the extensor digitorum. The mirror preferences are also consistent with the mean muscle activity in the extensor digitorum, wherein the padded plastic handle required the least amount of muscle activity; however, it is inconsistent within the other muscle groups. Eighty-five percent of the subjects surmised padded mirror handles were the most comfortable. Seventy-four percent of the subjects identified non-padded mirror handles were the least comfortable. This is consistent with the statistically significant main effect of padding in the flexor pollicis brevis. Within the flexor pollicis brevis, the padded metal handle required the least amount of muscle activity and the non-padded metal handle required the most muscle activity; however, it is inconsistent within the other muscle groups.

When comparing the overall subjective data to the statistically significant objective data, it appears that subjects had a good sense of what instrument required the least amount of work (μv). This was not true for the effects that were not statistically significant. When comparing each individual's mirror preferences with her muscle activity, less accuracy occurred, supporting the results of Spielholz et al; self-reports are the least precise measurement for evaluating ergonomics. The self-reports by the subjects in this study were less precise than the measurements of muscle activity using surface electromyography (sEMG) when evaluating comfort of mirror handles.

Previous studies demonstrated an increase in intracarpal tunnel pressure and an increase in tension forces in the finger flexor tendons when force is exerted. Results from evaluating static and biomechanical models concluded the tendon force is a function of hand size, position, and load. Opposition of movements in the finger flexor tendons is much higher than that of normal force acting on the fingers when normal force is exerted with only the finger tips. Studies by Hagg et al supported that different dose definitions of muscle activity should be applied depending on the tissue at risk. He also stated that the overexertion risk increases more than proportionally with increasing mechanical load. Dental hygienists pinch grasp mirrors several hours of the workday, often with pressure due to retracting the cheek and tongue. When applying the above research to the task of performing dental hygiene procedures, one might assume that as force is exerted during gripping and pinching activities, the magnitude of tensile strain in the tendons will increase, which augments the risk of muscle overexertion. Consequently, when considering force and the magnitude of tensile strain, the impact of even a small reduction of muscle activity may be significant in the prevention of WMSDs.

Recommendations for ergonomic instrumentation focus on alternating instruments and using a variety of handle diameters and weights within each instrument kit. Data from this study support this recommendation. The muscle activity response between the best and worst handle for each muscle group was of interest. Sixty-eight percent of the subjects in phase one and fifty-eight percent of the subjects in phase II had at least one mirror handle that was best for one muscle group and worst for a different muscle group at the same time. One could conclude that alternating instrument handles throughout each appointment would allow for varying muscles to work and rest throughout each appointment, which could improve musculoskeletal health.

Upon examining the data of each individual, it is notable that due to the complexity of the muscles and nervous system, the muscle response to the external load (mirror handles) was different for each subject. Some subjects had a decrease in muscle activity with lightweight handles while others had an increase in muscle activity associated with lightweight handles. This was also true for diameter and padding. Optimal handle trends were suggested by the main and interaction effects; however, there was no "one size fits all" handle. Tactile cues available at the end of finger movements provide a powerful stimulus for the control of the finger muscles.
and sensory cues, Santello et al found that tactile cues influenced hand postures as the hand contacted objects.\textsuperscript{33} Weight and texture are external variables that provide tactile cues and could affect muscle activity. This may perhaps explain why lightweight instruments decreased muscle activity in many of the subjects; however, in a limited number of subjects it caused an increase in muscle activity. A variety of handle textures are available to clinicians; however, this variable was not controlled for or measured in the present study. This needs to be an additional parameter proscribed in future studies.

**Limitations**

Due to prescribed manufacturer features (set diameters and weights); it was not possible to conduct a fully balanced design. The Acushy\textsuperscript{®} grip, used to pad instrument handles, was not compatible with the wide diameter instrument handles. This is why it was necessary to design the study to collect data in two phases. Although measures were taken to totally balance the study, they were not fully accomplished.

The pilot test used for power analysis was completed on three experienced dental hygiene faculty members. The subjects (N=19) used in this study were senior dental hygiene students. Overall, the subjects used in this study did not reflect the characteristics of the subjects in the pilot test. Using this population allowed for greater control of the external variables that could affect the study results, however, it greatly limited the variability of the data. Over half of the subjects used in the study were inexperienced in the dental field, which we hypothesize may have contaminated the power analysis. The power of the study was impaired by the predetermined sample not being large enough.

Hagg et al\textsuperscript{31} stated, “The indication of muscular fatigue in occupational field applications comprises a general problem since both, the EMG amplitude as well as the spectrum, depend not only upon the fatigue state but also on the produced force.” Force was not measured in this study, which makes comparing phase I and phase II data problematic because we cannot ascertain that equal force was used from one phase to the next. Data from each phase must be looked at as individual entities.

**General Remarks**

This exploratory study is the first randomized controlled trial exploring empirical evidence to support instrument modification choices in dental hygiene mirrors. While trends in muscle activity were observed under varying instrument characteristics, only some were statistically significant. Further research is necessary to ascertain the results.

This study had a homogenous anthropometry of hand demographics. The mean female hand breadth is 92 mm (± 6 mm).\textsuperscript{34} This was very comparable to our sample. Future ergonomic studies examining muscle activity should include examining diameter, weight, and padding on a larger, more diverse sample by which additional analyses to determine what role anthropometrics of the hand play in muscle activity should be explored. It is also of interest to explore the effects of load (resistance), such as that while retracting the cheek or tongue, while grasping dental hygiene mirrors. Examining muscle activity while scaling calculus with any of the above variables would also be beneficial. Ultimately, the utilization of biomechanical models and temporal neural networks to map and predict the interaction of muscle activity in a cross-sectional sample of dental hygienists is necessary to completely understand the relationships between muscles and external variables.

**Conclusion**

Altering the weight, diameter, and padding of dental hygiene instrument handles appears to have an affect on muscle activity; however, further research is needed to determine optimal handle design. Ergonomic adaptations to dental hygiene instrument handles seem to impact muscle activity; it may be possible to reduce work-related musculoskeletal disorders for dental hygienists by altering instrument designs during the workday. Self-reports of comfort by the subjects calibrated well with the statistically significant effects; however, they did not calibrate well with non-statistically significant effects. Each individual’s subjective assessment of comfort did not parallel the amount of muscle activity objectively measured using surface electromyography (sEMG). The individual sEMG data suggests instrument handles should be tailored to best fit each individual. Ultimately, a biomechanical means of predicting muscle activity would allow for better selection of ergonomically focused instruments.
Acknowledgements

The authors wish to thank The Rinehart Foundation for funding this project and Acushy Product Company, American Eagle, Hu-Friedy, Nordent, Premier, and Paradise Dental Technologies for donating products to be evaluated.

Notes

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References

Ethics Instruction in the Dental Hygiene Curriculum

Mark G Kacerik, Renee G Prajer and Cynthia Conrad

Purpose. Dental hygiene ethics is an essential component of the dental hygiene curriculum. The accreditation standards for dental hygiene education state that graduates must be competent in applying ethical concepts to the provision and/or support of oral health care services. Although the standards for entry into the profession of dental hygiene emphasize the importance of ethical reasoning, there is little published research specific to ethics instruction in dental hygiene programs. The purpose of this study was to assess how ethics is taught in the dental hygiene curriculum.

Methods. A 17-item survey was designed and distributed to 261 accredited dental hygiene programs in the United States for a response rate of 56% (N=147). The survey requested that participants provide information on teaching and evaluation methodologies, didactic and clinical hours of instruction, individuals responsible for providing instruction, and the degree of emphasis placed on ethics and integration of ethical reasoning within the dental hygiene curriculum.

Results. Results of the survey reflect that dental hygiene programs devote a mean of 20.2 hours to teaching dental hygiene ethics in the didactic component of the curriculum. With regard to the clinical component of the curriculum, 63% of respondents indicated that 10 or less hours are devoted to ethics instruction. These results show an increase in didactic hours of instruction from previous studies where the mean hours of instruction ranged from 7 to 11.7 hours. Results showed 64% of respondents offered a separate course in ethics; however, 82% of programs surveyed indicated that ethics was incorporated into one or more dental hygiene courses with 98% utilizing dental hygiene faculty to provide instruction. Most programs utilized a variety of instructional methods to teach ethics with the majority employing class discussion and lecture (99% and 97% respectively). The type of institution—technical college, community college, four-year university with a dental school, and four-year university without a dental school—had little influence on the degree of emphasis placed on teaching ethics. Although the number of hours devoted to ethics instruction has increased, 43% of respondents indicated that they would like to see more emphasis placed on ethics in the program with which they are affiliated.

Conclusion. This study reveals that programs have taken measures to employ a variety of teaching strategies to ensure that students are competent in applying ethical concepts in the provision of oral health care. However, programs continue to rely primarily on traditional methods of instruction and evaluation such as lecture, discussion, quizzes, and written assignments. Inferential analysis focusing on the influence of the type of institution, showed that in general, the type of institution has little influence on the level of emphasis placed on teaching ethics in dental hygiene curricula. It is recommended that dental hygiene programs continue to implement and evaluate instructional methods that simulate real life experiences and emphasize ethical concepts that promote comprehensive oral health care. Future studies should investigate the effectiveness of ethics instruction within dental hygiene curricula.
Keywords: Ethic instruction, curriculum assessment, dental hygiene education, professional responsibility, code of ethics

Introduction

As professionals, dental hygienists have responsibilities to their clients, employers, and the profession. It is essential that dental hygienists be prepared to make decisions based on ethical reasoning, and for dental hygiene programs to prepare them for this responsibility. How then are dental hygiene programs preparing graduates to practice ethically and make ethical decisions? The purpose of this study was to assess how ethics is being taught in accredited dental hygiene programs. The researchers are hopeful that educators will utilize this information to assist them in program assessment and planning.

Review of Literature

"Competencies for Entry into the Profession of Dental Hygiene" identifies the skills that are expected of a dental hygienist upon entering the profession. These competencies are divided into five domains: core competencies, health promotion and disease prevention, community involvement, patient/client care, and professional growth and development. Dental hygiene programs are responsible for ensuring that graduates demonstrate competency in all of the domains, beginning with the core competencies, which provide the foundation for all the roles of the dental hygienist. Defined within the core competencies are the ethics, values, skills, and knowledge that are integral to all aspects of the profession.

The accreditation standards for dental hygiene education programs state that "[g]raduates must be competent in applying ethical, legal, and regulatory concepts to the provision and/or support of oral health care services." The agency that accredits dental hygiene educational programs, the American Dental Association's (ADA) Commission on Dental Accreditation (CODA), has identified several general guidelines for programs to demonstrate evidence of compliance in meeting this standard including: written course documentation in ethics, ethical reasoning and professionalism, evaluation mechanisms designed to monitor knowledge of performance, and outcomes assessment mechanisms.

Although the standards for entry into the profession of dental hygiene emphasize the importance of ethical reasoning, there is little published research specific to the instruction of ethics in dental hygiene programs. A 1982 study on ethics instruction in dental hygiene programs found that although ethics was a component of the curriculum, the hours of instruction and teaching methods varied considerably among programs.

In a series of studies conducted on the status of dental ethics instruction, results suggest an increased emphasis in providing ethics instruction in dental schools. A 1998 survey of dental schools showed that the number of programs offering at least one course in dental ethics went from 79% in 1986 to 91% in 1998. However, it was revealed that even though there was an increase in ethics instruction, the total number of credit hours devoted to ethics remained relatively low in comparison to the overall curriculum.

Current literature questions the effectiveness of ethics instruction in dental curricula. It has been suggested that teaching ethics is different from teaching a student to make ethical decisions as an individual. Some educators believe that one's personal ethics stem from an introspective standpoint in order to change one's behavior or beliefs and in order for a professional to practice ethically. Perhaps this is consistent with the notion that ethics education and practicing ethics, as an individual/professional, are not necessarily congruent. Research has indicated that practicing dental hygienists felt that their ethical beliefs were developed outside of their educational experience, yet they noted that role models contributed to their ethical developments.

One concern with regard to teaching ethics is who, based on qualifications, should be responsible for providing the instruction. Historically in dental hygiene and dental programs, dental hygiene or dental faculty have taught ethics courses. In a 1982 study by Jong and Heine, 50% of dental hygiene faculty surveyed indicated that they did not possess adequate knowledge of moral philosophy to select readings or to bring out important theories to deal with moral dilemmas. Although
it would be ideal to have a dental health care professional with a Ph.D. in philosophy teach the ethics course, this is not a realistic expectation. A more practical approach to ethics instruction would be team-teaching so that colleagues could rely on each other's area of specialty to supplement the knowledge that they do not have.6

How successful dental hygiene programs have been in providing students with ethics instruction can be assessed by looking at how dental hygienists deal with ethical dilemmas that they encounter in practice. In a study by Gaston et al,7 practicing dental hygienists were surveyed to determine the types of ethical problems they encountered and the type of instruction they received in ethical theory. Eighty-six percent of dental hygienists reported that they had formal instruction in ethical theory, with 56% receiving this instruction in a separate course, rather than as part of another course. The majority of respondents, 61%, reported that the instruction they received had been lecture only; 38% reported having discussion/demonstration instruction. Most of the responding dental hygienists reported that they encountered ethical problems that they did not feel prepared to address. From this study, the researchers concluded that there should be a review of the curriculum with regard to ethics instruction to better prepare dental hygienists for addressing ethical problems.7

An exploratory study conducted by Christie et al8 indicated that the majority of faculty value the importance of developing student competence in ethical reasoning and professional responsibility, but find it difficult to evaluate competence in this domain. The researchers concluded that faculty need training in assessment of ethical reasoning and the utilization of diverse methods of practical evaluation tools such as test cases, case presentations, research projects, and portfolios to assess students' level of competence in regards to ethics.8 Critical thinking has been advocated as an approach to ethics education in the clinical learning environment. Performance assessments such as authentic evaluation can be utilized to provide students with experiences that mimic real life situations including cases and standardized patients.9,10

Methods

A survey was designed to gather data on instructional methodologies and the degree of emphasis placed on ethical reasoning and professional responsibility within dental hygiene programs. The survey requested that participants respond to questions regarding their teaching methodologies in ethics, and how many hours of instruction in dental hygiene ethics, both didactic and clinical hours, they included in their curriculum. The 17-item survey consisted of both closed-ended questions and open-ended questions, as well as a section where participants were asked to evaluate the degree of emphasis placed on ethics within the dental hygiene curriculum, from a didactic and clinical perspective, based on the ADHA Code of Ethics for Dental Hygienists.11 The survey was distributed to faculty within the department and revisions were made to improve the clarity of survey items in relation to the rating scale used to assess the level of emphasis placed on ethics. A five-point Likert rating scale was used with (5) indicating a very high level of emphasis and (1) indicating a very low level of emphasis. The survey, a cover letter and a self-addressed, postage paid envelope were mailed to program directors of 261 accredited dental hygiene programs in the United States. Both the surveys and the return envelopes were coded to identify non-respondents for a follow-up mailing. Participants were informed that responses to the survey would be confidential and that surveys were numbered to monitor responses and provide follow-up mailings if necessary. The program directors were given four weeks to complete the survey. One hundred and forty-seven responses were received, resulting in a 56% response rate. Some surveys had incomplete information and were not appropriate for statistical analysis. As a result, some of the analyses that follow include less than 147 cases. In addition, individuals completing the survey included multiple responses for items that required a single response, resulting in percentages totaling more than 100%. Although the surveys were mailed to directors, it is not known if the directors themselves completed the survey instrument, or if it was given to faculty to complete. The results of the survey were quantified and an Excel database was utilized to obtain descriptive statistics. The researchers used the same database in inferential analysis using SPSS version 12.
Results

Descriptive Findings

When asked how ethical concepts are incorporated in the curriculum, the researchers received multiple responses. Of the respondents, 64% indicated that ethics was taught in a separate course, 22% indicated it was incorporated into a dental hygiene course, 60% indicated that ethics was incorporated into several dental hygiene courses, and 7% indicated "other," noting that ethics was incorporated throughout the curriculum and modeled by faculty.

The amount of hours devoted to teaching ethics in the didactic portion of the curriculum varied with 41% devoting 11-20 hours of instruction and 27% devoting 0-10 hours. A mean of 20.2 hours of didactic instruction is devoted to ethics (Figure 1).

![Figure 1. What Percentage of Ethical Concepts are Calculated into the Didactic](image)

With regard to the clinical component of the curriculum, 63% of respondents indicated that 10 or less clinical hours are devoted to ethics instruction, 11% offer 11-20 hours, 5% offer 21-30 hours, 4% offer 31-40 hours, and 17% offer 41 or more hours of instruction in the clinical component (n=81 or 55% of respondents). Those that did not respond indicated it was difficult to calculate the hours devoted to instruction in the clinic setting.

Multiple responses were received from participants when asked who is responsible for teaching ethics. Ninety-eight percent use dental hygiene faculty to provide instruction, 3% use philosophy faculty, while 5% use dentists, lawyers, and guests speakers.

Results indicated that the majority of programs employ multiple strategies for providing ethics instruction. Lecture, class discussion, and case scenarios were the most frequently used methods. Other methods include: debates, student portfolios, written assignments, online discussion boards, and guest lecturers. Figure 2 provides percentages of the methods of instruction used to teach ethics.
Programs utilize a variety of reading resources for ethics assignments. Of the respondents, 94% use the American Dental Hygienists’ Association Code of Ethics for Dental Hygienist as a resource, 73% use current literature, 61% use textbooks that are required for other dental hygiene classes, and 63% require a separate textbook on dental hygiene ethics. Other reading resources include state practice acts, videos, state board newsletters, and online resources.

Evaluation systems also vary with the responding programs; 89% of respondents use tests/quizzes and 73% use written assignments to evaluate students on ethical concepts. Of the responding programs, 19% reported that no specific testing was employed. Rather, students are evaluated on their overall behavior/professionalism (Figure 3).

Ninety-two percent of programs surveyed evaluate the students’ use of ethical concepts in the clinical setting. Three percent indicated they do not evaluate students in the clinical setting, while others noted they do not provide specific evaluation and/or only address issues if breached.

Survey results show that 60% of the respondents calculate ethical concepts into the students’ clinical grade with a weight of 1-10%, 24% calculate ethical concepts into the students’ clinical grade with a weight of 11-20%, 6% calculate ethical concepts into the students’ clinical grade with a weight of 21-30%, 4% calculate ethical concepts into the students’ clinical grade with a weight of 31-40%, and 1% calculate ethical concepts into the students’ clinical grade with a weight of 41-50%.
grade with a weight of greater than 30%, and 6% do not calculate the use of ethical concepts into students' grade at all. Figure 4 shows what percentage of ethical concepts is calculated into the students' clinic grade.

**Figure 4. What Percentage of Ethical Concepts are Calculated into the Students Clinic Grade**

When asked, "would you like to see more emphasis placed on ethics in the program that you are affiliated with," 43% responded yes, 50% responded no, and 7% did not respond. Reasons cited for responding no included, they were satisfied with the current level of emphasis, or there is no room in the curriculum.

The survey results, with regard to the level of emphasis that should be placed on teaching ethics in the dental hygiene curriculum, indicated that 72% of respondents felt a very high level should be placed on teaching ethics, 25% a high level, 3% an intermediate level, and no respondents indicated a low or very low level.

When respondents were asked the most appropriate strategy for incorporating ethics into the dental hygiene curriculum, multiple responses were reported. Eighty percent of respondents indicated that ethics should be incorporated throughout the dental hygiene curriculum, fifty percent responded that a separate course on ethics should be offered, and ten percent recommended ethics be incorporated into a dental hygiene course. With regard to the level of emphasis placed on ethical concepts in the didactic and clinical component, results showed the majority of respondents place very high emphasis on all areas of ethical reasoning and professional responsibility, except scientific investigation/research and autonomy. (Table I) (Table II).
<table>
<thead>
<tr>
<th>Table I. Level of Emphasis Placed on Teaching Core Values and Standards of Professional Responsibility in the Didactic Component of the Curriculum N=147</th>
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<td>Ethical decision making</td>
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<td>Ethical behavior</td>
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<tr>
<td>Professional responsibility to client</td>
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<td>Professional responsibility to employees/employers</td>
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<td>Professional responsibility to the profession</td>
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<td>Professional responsibility to the community/society</td>
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<tr>
<td>Professional responsibility to scientific investigation/research</td>
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<td>Autonomy (“self-governance”)</td>
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<td>Nonmaleficence (“do no harm”)</td>
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<td>Beneficence (“do good”)</td>
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<td>Justice (“fairness”)</td>
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<tr>
<td>Veracity (“truthfulness”)</td>
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<tr>
<td>Table II. Level of Emphasis Placed on Teaching Core Values and Standards of Professional Responsibility in the Clinical Component of the Curriculum N=147</td>
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<td>Ethical behavior</td>
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<tr>
<td>Professional responsibility to client</td>
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<tr>
<td>Professional responsibility to colleagues</td>
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<td>Professional responsibility to employees/employers</td>
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<tr>
<td>Professional responsibility to the profession</td>
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<tr>
<td>Professional responsibility to the community/society</td>
</tr>
<tr>
<td>Professional responsibility to scientific investigation/research</td>
</tr>
<tr>
<td>Autonomy (“self-governance”)</td>
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<tr>
<td>Nonmaleficence (“do no harm”)</td>
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<tr>
<td>Beneficence (“do good”)</td>
</tr>
<tr>
<td>Justice (“fairness”)</td>
</tr>
<tr>
<td>Veracity (“truthfulness”)</td>
</tr>
</tbody>
</table>
**Inferential Findings**

One hypothesis possibly explaining the varying emphasis placed on teaching ethics is the differences between the different types of institutions and the degrees they offer. For this study, the researchers classified the types of institutions as technical college, community or junior college, four-year university with a dental school, or four-year university without a dental school. Each respondent was asked to name the highest degree offered at his or her institution, from among a choice of a certificate, associate degree, baccalaureate degree, or master's degree. It may be that the varying levels of degrees and/or the type of institution may play a role in determining the level of emphasis placed on teaching ethics in didactic or clinical areas.

In this sample, the majority of degrees offered as the institution's highest degree in dental hygiene is the associate degree with 103. Most of those degrees were offered by community or junior colleges (84). This contingency analysis also revealed a chi-square value of 122.055, significant at the .001 level, which indicates a significant association between the type of institution and the degree offered. The strength of this relationship is moderate with a lambda of .427, a Cramer’s V of .530, and a contingency coefficient of .676.

**Differences in the Type of Institution**

The researchers first looked at the ethics-related questions of the survey and the variances of those responses depending on the type of institution. For this part of the analysis, the researchers created two, scaled variables that aggregated and averaged the questions regarding ethics and professional responsibility in the didactic component of a program. In order to maximize the knowledge gleaned from the data, the authors created two, new scaled variables in the same way for the questions regarding ethics and professional responsibility in the clinical areas of the programs. The authors created these variables by scaling together the 14 questions of the instrument in each substantive area: didactic ethics, didactic professional responsibility, clinical ethics, and clinical professional responsibility. In each case, the responses to the 14 questions were averaged together to give a single score. These scores appear in Table III. These four, scaled variables provide insight into the overall emphasis of each respondent in the areas mentioned above. The levels of the scale are 1. very low; 2. low; 3. middle; 4. high; and 5. very high, corresponding to the original questions from which the scaled questions derive. The measures in the table below are the means from the scaled variables, which reflect the nuances created by the scales and give greater understanding to the subtle differences between the institutional types.

<table>
<thead>
<tr>
<th>Type of Institution</th>
<th>Didactic Ethics Emphasis</th>
<th>Didactic Professional Responsibility Emphasis</th>
<th>Clinical Ethics Emphasis</th>
<th>Clinical Professional Responsibility Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical College</td>
<td>4.70</td>
<td>4.31</td>
<td>4.81</td>
<td>4.26</td>
</tr>
<tr>
<td>Community or Junior College</td>
<td>4.71</td>
<td>4.32</td>
<td>4.74</td>
<td>4.33</td>
</tr>
<tr>
<td>Four Year University with Dental School</td>
<td>4.78</td>
<td>4.52</td>
<td>4.52</td>
<td>4.51</td>
</tr>
<tr>
<td>Four Year University without Dental School</td>
<td>4.58</td>
<td>4.39</td>
<td>4.66</td>
<td>4.39</td>
</tr>
</tbody>
</table>

Clearly there is less emphasis on professional responsibility than ethics in all institutions. However, the emphasis in all four areas is very similar with only very slight differences.

Next, the researchers looked for differences in the continuous measures of the study such as the clock hours devoted to didactic and clinical teaching of ethics and the percent of grades derived from demonstrated knowledge of ethical concepts. Table IV shows the findings of that analysis.

- 9 -
In this analysis, technical colleges seem to devote a noticeably lower number of hours to teaching ethics in both the didactic and clinical areas. All other means seem rather similar, especially considering the sometimes large standard deviations.

The researchers used an analysis of variance (ANOVA) analysis using the type of institution as the factor and all of the variables in Table V to see if the variance among the types of institutions was greater than the variance among the institutions of the same type. No significant findings resulted in an ANOVA using the type of institution and the scaled variables on the teaching of didactic ethics or professional responsibility.

A chi-square analysis was the next step in the analysis of the influence of the type of institution on the emphasis on ethics in teaching. The only statistically significant variable associated with the type of institution was the variable asking whether they used written assignments. That association resulted in a chi-square number of 9.097, significant at the .029 level. Further analysis showed that the association was rather weak, with a non-significant lambda, a contingency coefficient of .241, and a Cramer's V of .249.

Overall, the type of institution seems to have little influence on the level of emphasis in teaching ethics in dental hygiene curricula. Therefore, little may be empirically attributed to the type of institution insofar as instruction in ethics is concerned.

### Differences in the Highest Degrees Offered

Dental hygiene programs offer one of four degrees as their highest, academic degree. Beginning with a certificate, most programs also offer either an associate degree, baccalaureate degree, or a master's degree in dental hygiene. The researchers considered the influence such differences in degree offerings might have on the level of emphasis in teaching ethics in each program. Consequently, they performed the following statistical tests to look for that influence. Because of a threat to validity created by disparity in the numbers of respondents in each degree category, the authors combined the certificate and associate programs into a single group entitled "pre-baccalaureate." Because of the low number of respondents who offered master level programs (6), the authors dropped them from further analysis. For the following analysis, the researchers used the scaled, aggregated variables and looked at the means of each of those variables, and divided them into groups based on the highest degree offered by a program. The results follow in Table V.

### Table IV.

<table>
<thead>
<tr>
<th>Type of Institution</th>
<th>Didactic Clock Hours</th>
<th>Clinical Clock Hours</th>
<th>Percent of Grade from Ethical Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Respondents</td>
<td>Mean 20.20</td>
<td>Mean 50.59</td>
<td>Mean 2.38</td>
</tr>
<tr>
<td></td>
<td>Standard Dev. 14.27</td>
<td>Standard Dev. 124.71</td>
<td>Standard Dev. .85</td>
</tr>
<tr>
<td>Technical College</td>
<td>Mean 15.53</td>
<td>Mean 17.3</td>
<td>Mean 2.31</td>
</tr>
<tr>
<td></td>
<td>Standard Dev. 12.12</td>
<td>Standard Dev. 19.54</td>
<td>Standard Dev. .630</td>
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<tr>
<td>Community or Junior College</td>
<td>Mean 20.87</td>
<td>Mean 63.25</td>
<td>Mean 2.51</td>
</tr>
<tr>
<td></td>
<td>Standard Dev. 14.95</td>
<td>Standard Dev. 147.63</td>
<td>Standard Dev. .88</td>
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<td>Mean 18.94</td>
<td>Mean 23.88</td>
<td>Mean 2.0</td>
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<td></td>
<td>Standard Dev. 12.64</td>
<td>Standard Dev. 58.04</td>
<td>Standard Dev. .555</td>
</tr>
<tr>
<td>Four Year University without Dental School</td>
<td>Mean 21.72</td>
<td>Mean 36.18</td>
<td>Mean 2.17</td>
</tr>
<tr>
<td></td>
<td>Standard Dev. 14.12</td>
<td>Standard Dev. 76.93</td>
<td>Standard Dev. .94</td>
</tr>
</tbody>
</table>

A chi-square analysis was the next step in the analysis of the influence of the type of institution on the emphasis on ethics in teaching. The only statistically significant variable associated with the type of institution was the variable asking whether they used written assignments. That association resulted in a chi-square number of 9.097, significant at the .029 level. Further analysis showed that the association was rather weak, with a non-significant lambda, a contingency coefficient of .241, and a Cramer's V of .249.

Overall, the type of institution seems to have little influence on the level of emphasis in teaching ethics in dental hygiene curricula. Therefore, little may be empirically attributed to the type of institution insofar as instruction in ethics is concerned.

### Table V.

<table>
<thead>
<tr>
<th>Highest Degree Offered</th>
<th>Didactic Ethics Emphasis</th>
<th>Didactic Professional Responsibility Emphasis</th>
<th>Clinical Ethics Emphasis</th>
<th>Clinical Professional Responsibility Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-baccalaureate</td>
<td>4.72</td>
<td>4.36</td>
<td>4.76</td>
<td>4.35</td>
</tr>
<tr>
<td>(n=105)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baccalaureate</td>
<td>4.68</td>
<td>4.42</td>
<td>4.65</td>
<td>4.41</td>
</tr>
<tr>
<td>(n=31)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interestingly, this analysis shows the inverse emphases between pre-baccalaureate and baccalaureate programs. On average, pre-baccalaureate programs place a higher emphasis on didactic ethics and clinical ethics. In contrast, baccalaureate programs generally place a higher emphasis on professional responsibility and clinical professional responsibility.

In the next phase of analysis, the researchers looked for effects of various levels of degrees regarding the continuous variables available from the survey. The results of that analysis are in Table VI.

<table>
<thead>
<tr>
<th>Type of Degree Offered</th>
<th>Didactic Clock Hours</th>
<th>Clinical Clock Hours</th>
<th>Percent of Grade from Ethical Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-baccalaureate (n=105)</td>
<td>Mean: 20.87 Standard Dev: 15.46</td>
<td>Mean: 55.19 Standard Dev: 137.7</td>
<td>Mean: 2.45 Standard Dev: .85</td>
</tr>
<tr>
<td>Baccalaureate (n=33)</td>
<td>Mean: 18.97 Standard Dev: 11.1</td>
<td>Mean: 46.33 Standard Dev: 77.18</td>
<td>Mean: 2.29 Standard Dev: .783</td>
</tr>
</tbody>
</table>

Overall, baccalaureate degree programs devote fewer clock hours to both didactic and clinical ethics emphases. In addition, a lower percentage of students' grades in baccalaureate degree programs derive from ethical concepts.

To test this finding further, the researchers performed a t test analysis comparing baccalaureate and pre-baccalaureate programs in terms of differences in clock hours dedicated to teaching ethics in the didactic area, clock hours dedicated to teaching ethics in the clinical component, and percent of grade derived from ethical concepts. The t test analysis did not show significant relationships. Likewise, when the researchers analyzed the scaled variables for ethics and professional responsibility using a t test analysis, there were no significant relationships.

In a further effort to understand the influence of the highest degree offered (pre-baccalaureate or baccalaureate) on the curriculum aspects regarding ethics, the researchers used chi-square analysis to examine the effects on some of the discrete variables of the study. From this analysis, four significant associations emerged.

Whether or not the respondents used required chapters from texts for other classes showed a statistically significant relationship with a chi-square of 6.937, significant at the .008 level. The phi for this two-by-two table was .223, showing a weak relationship.

Use of "other" evaluation mechanisms to evaluate students' ethics understanding also showed a significant association with a chi-square of 4.45, significant at the .035 level. The phi of this two-by-two table was .179, again showing a weak relationship.

The type of institution showed a significant association with the pre-baccalaureate or baccalaureate programs with a chi-square of 82.098, significant at the .0000 level. The Cramer's V for this four-by-two table was .769, showing, as would be expected, a strong association.

The final association that proved significant was the number of students per graduating class. Grouped into 11-15, 16-20, 21-30, 31-40, or 41+, analysis revealed a chi-square of 20.755, significant at the .0000 level. The gamma for this association was .643, showing a strong relationship.

Chi-square analysis of all other discrete variables with the pre-baccalaureate and baccalaureate distinction discovered no other statistically significant associations.

Taken as a whole, it seems that the differences between pre-baccalaureate and baccalaureate programs are not very notable. Further research into differences in all the different degree levels, including graduate, might provide more insight into the differences in teaching ethics that may exist.
Discussion

Although the research indicates that the mean hours of ethics instruction has increased, 43% of respondents indicated they would like more emphasis placed on ethics within their institution. A previous study regarding ethics instruction conducted in 1982 indicated that 72% of instructors felt that there was enough emphasis placed on ethics in the curriculum. Further research is needed to determine why a greater percentage of respondents would like to see more emphasis placed on ethics instruction in this study versus the previous study in spite of the increase in mean hours of instruction that has occurred over the 20+ year period. Perhaps the continued desire for greater emphasis on ethics instruction is relative to the intricacy of dental health and overall health, societal changes, and generational differences.

In a study by Gaston et al, the researchers found that dental hygienists reported that they were not prepared to handle ethical problems that they encountered in the private sector. The researchers found that 63% of respondents devoted 10 or less hours of instruction in the clinical component of the curriculum, with the majority of evaluation being written assessments. The mean percentage of students' clinic grades deriving from ethics was approximately 2%. These findings support previous research in which students did not feel prepared to handle ethical dilemmas after graduating, and the need to increase authentic instruction and evaluation such as engaged real-life learning, role-playing, workshops, and case studies. Educators must consider not only the quantity of instruction, but also the quality. Shifting to authentic methods of instruction and evaluation may better prepare students for situations they encounter, and ensure student competence in handling these dilemmas. In an article by Metcalf et al, gaming is being used to assist nursing students with ethics, ethical dilemmas, and decision making. Metcalf et al concluded that the utilization of games when teaching ethics made for a nontthreatening environment that allowed students to understand the value of ethics in their chosen profession and to "learn to live their ethics." However, making this shift may present some challenges. A study by Christie et al indicated that faculty found objectively evaluating student competency, with regard to ethics in the clinical setting, a difficult task.

The research indicates that the majority of individuals teaching ethics in the dental hygiene curriculum are dental hygiene faculty. As the literature review indicates, team-teaching ethics may allow colleagues to incorporate their areas of expertise into the ethics curriculum. One method of achieving this would be to collaborate with faculty from other disciplines such as philosophy or psychology. When reviewing how ethics instruction is incorporated within different degree and certificate programs, the analysis of the data showed that there was no significant difference. However, the number of programs offering a separate course in ethics has more than doubled from 31.3% to 64% since 1982, which may account for the increase in mean hours of instruction.

An area of interest with regard to the level of emphasis placed on teaching core values and professional responsibility was that the majority of respondents placed a very high level of emphasis in all areas except scientific investigation/research and autonomy. Clearly, scientific investigation/research is a valuable aspect in the advancement of the dental hygiene profession and for the dental hygienist to critically evaluate research to determine the efficacy of new theories, interventions, and technology in order to provide care that is based on scientific evidence. Autonomy is important in dental hygiene treatment to ensure patients' rights with regard to treatment and treatment options. In addition, it assures the hygienist's right to refuse to provide care that does not meet recognized standards.

The researchers note the following limitations with the study. The survey instrument was self designed and had no established validity or reliability. Respondents indicated it was difficult to compute the number of clock hours devoted to ethics instruction in the clinical component of the curriculum. Respondents did not respond to all items in the survey. Respondents selected more than one response for questions that were intended for a single response. Additionally, although the researchers included questions on who is responsible for teaching ethics, they did not ask respondents to indicate their opinion as to who should teach ethics within the dental hygiene curriculum.
Conclusion

Ethics is an integral component of dental hygiene education as well as the profession; however, this study revealed that a low proportion of students' clinic grade derives from ethical concepts. Findings also showed that although there is variance from program to program, there is no consistent explanation for such variance based on the type of institution offering the program or the highest degree offered by the program.

It is clear that dental hygiene programs have taken steps to employ a variety of teaching strategies to assist students in developing the skills needed to apply ethical concepts in the provision of oral health care. However, the effectiveness of instruction should be assessed. This is evident by the number of respondents who indicated a desire to see a greater emphasis on ethics instruction despite the increase in mean hours. Future studies should investigate the effectiveness of ethics instruction within the dental hygiene curriculum and how ethics instruction in other allied health disciplines could be applied to dental hygiene. Such efforts can only enhance the quality of education students receive and in turn the quality of care provided to patients.

Acknowledgements

Notes

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References

Differences Between Herbal and Nonherbal Users in Dental Practice

Karen K Tam, Cynthia C Gadbury-Amyot, Charles M Cobb and Karen B Williams

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Purpose. The purposes of this study were to describe basic demographics and health belief differences between herb users and nonherb users, any potential herb-drug interactions, and examine the association between dental chart noted and questionnaire self-reported use of herbal remedies.

Methods. A 3-part survey instrument was administered to a convenience sample of 149 individuals at a dental clinic and two dental practices. The first part ascertained demographic information and prescription drug use using open-ended and closed-ended questions. The second part listed 51 individual/combination herbs and the third part assessed healthcare behavior using a 5-point Likert scale. A chart audit compared written responses between a patient’s medical/dental history chart and his/her survey on herbal use. Descriptive analyses and MANOVA were used to examine the relationship between herbal users and nonusers.

Results. Eighty participants (54%) reported using some form of herbs. They were characterized as mostly female (71%), who were less likely to disclose herbal usage to practitioners (p< .05), believed in herbal effectiveness (p< .05), and reported a more positive perceived level of health status compared to nonusers (p= .02). Although herb users reported a willingness to disclose use of herbs to health practitioners, only three patients had any written documentation of their herb use in their medical/dental health chart (p= .0001). Fifty-five herb users were also taking prescription drugs (69%) that could potentially lead to herb-drug interactions.

Conclusion. The findings provide supportive evidence that dental hygiene practitioners need to be aware of their patients’ use of herbs. Knowing potential risks, side effects, and possible drug interactions is necessary for patient management and each patient’s oral health.

Keywords: Herbal remedies, herb-drug interactions, alternative medicine, public health

Introduction

Alternative medicine has become a significant public health concern among health care professionals. More than one-half of the US adult population uses some form of alternative therapy to treat actual or perceived ailments and/or to prevent perceived threats to their general health. Alternative therapy encompasses a wide variety of methods including reflexology, acupuncture, megavitamin therapy, folk remedies, and herbal remedies. Herbal remedies or herbal medicines are defined
as the use of preparations and medications derived from botanical components such as roots, leaves, and flowers to promote healing.5 These components can be used in raw, pill, or capsule form. The current study focused on the use of herbal remedies.

In the first US national survey on the number of people using herbal therapies, Eisenberg documented an almost 10% increase from 2.5% in 1990 to 12.1% in 1997 among those who used herbal therapies.9 Since the time of Eisenberg's study, other analyses have found similar results in the increase of herbal use among people in the United States.14-16

Issues related to quality control, safety, and effectiveness are major concerns with herbal medicine. Today, there is an aggressive push to collect data on popular herbal remedies, their efficacy, and their potential adverse affects when used either alone or with other medications, or medical treatments. Several long-term studies to answer these questions have been undertaken in the United States with the support of the National Center for Complementary and Alternative Medicine (NCCAM), a component of the National Institute of Health, in collaboration with various universities around the country.13,17 With herbal sales now estimated to be a $4 billion a year industry, health professionals increasingly turn to researchers to provide scientific information on herbal efficacy and safety.18

Although there are numerous studies regarding medical patients using herbal remedies, there is an absence of studies examining the impact of herbal remedies on dental patients. In dentistry, medications are prescribed for many reasons, including treating oral disease and preventing infections after surgical procedures such as tooth extractions. Therefore, maintaining a current medical history of each patient is vitally important. It has been stated that the most common cause of prescription drug related interactions is the dental practitioner's lack of information about the patient's medical history;14,21 including whether or not the patient is using dietary supplements and herbal remedies. Some herbs have the potential to interact with other medications, which can affect dental management and treatment.

People choose to use herbal remedies for a number of reasons. According to a Harvard University informal survey, one in three dental patients acknowledged using one, or a combination of, herbal medication(s).3 Therefore, the purposes of this study were: to describe the basic demographics and health belief differences between herb users and nonherb users; to address any potential drug-herb interactions; and to examine the association between dental chart noted and questionnaire self-reported use of herbal remedies.

**Review of the Literature**

The use of herbal plants extends back to the Neanderthal period.8 For thousands of years, people have used herbs to cure and prevent disease, especially in Europe and Asia where, to date, physicians still prescribe natural remedies.19-22 By the 1900s, with advanced conventional medicine, the use of herbs began to diminish in the United States.23 With a rising interest in holistic health, herbal remedies have steadily regained public acceptance and popularity from the 1960s to present.1,8,18

The requirements for monitoring the safety and efficacy of herbal medicines is not the same as for prescription drugs. Unlike prescription drugs, herbal medicines are not required to undergo extensive research to demonstrate safety, efficacy, and quality control. In 1994, under tremendous pressure from consumers and health food stores, Congress passed the Dietary Supplement Health and Education Act (DSHEA), which defined herbal remedies as dietary supplements.4,8,22 Still, there is no FDA review or approval of these supplement products and their ingredients. Food additives are submitted to a more rigorous approval process than herbal products.10,24 Under the DSHEA, the responsibility falls on the consumer to alert the FDA with questions about a product's safety. Once alerted, the FDA must prove the product unsafe before any restrictions can be placed on the product.8,22,24 By 1998, the FDA required that labels on herbal products must inform consumers that the herbal manufacturer's product "is not intended to diagnose, treat, cure, or prevent any disease."22,24 Statements that once said, "decreases blood pressure" were changed to "promotes vascular health."
The newest proposed ruling regarding herbal products (2003) by the FDA states that dietary supplement manufacturers are now required to follow good manufacturing practices in the way they manufacture, pack, and store their products. This will ensure accurate labeling and unadulterated products as well as enforce better quality control and testing of manufactured dietary supplements and their ingredients. This is a big step since quality control on herbs has been difficult in the past. Herbs can vary from batch to batch as a result of herb plant variation. Batches of herbal plants may become tainted during the processing stages of cultivation, harvesting, and storing. In some herbal plants, different parts of the plant (stem, leaves, or roots) contain varying degrees of potency or toxicity when processed. If the poisonous part of a plant is processed, the results could be toxic.

Although most herbs are relatively safe, the concern here is that most reported reactions caused by herbs are usually mild and may be overlooked by the people who took them as well as healthcare practitioners. Common reactions include: headaches, diarrhea, nausea, dermatitis, allergic reactions, dizziness, palpitations, photosensitivity, insomnia, tiredness, agitation, and sedation. In higher doses, herbal remedies may cause severe symptoms, and may include hematomas, hepatotoxicity, abdominal distention, and liver disease.

Another important concern is patient disclosure of herbal use. Research on patient disclosure of herbal use in the United States has been contradictory. Several empirical survey research studies on herbal use disclosure reveal that approximately 50 to 70% of patients do not consult their general practitioners about their herbal use. Identified reasons for lack of disclosure of herbal use relates to the patient's perception of a poor or negative attitude of healthcare practitioners regarding herbal use and a general lack of communication between healthcare practitioners and their patients. Most patients do not disclose herbal use to their healthcare providers believing herbs, as dietary supplements, are naturally safe.

In contrast, a recent survey conducted by Klepser et al found that herb users were actually open to disclosing their herbal use to their physicians and believed that it was important for their physicians to be aware of their herbal use. However, the investigators did not report if those patients were currently revealing herbal information to their physicians. A national survey conducted by the Consumers Union in 2000 found that 60% of the respondents who reported using herbs disclosed their use to their doctors, and felt comfortable doing so. These respondents further reported that 55% of their doctors expressed approval of the use of alternative therapies, while 40% were neutral, and 5% disapproved. The results from this national survey suggest that physicians in the United States may be changing their attitudes toward herb use when compared to previous studies on the attitudes of medical physicians on alternative medicine.

Despite practitioners' concerns about herbal safety, efficacy, and disclosure, over-the-counter herbal remedies remain a multi-billion dollar enterprise. In several studies, most Americans reported that they would first try self-medication with over-the-counter medications and herbal remedies before visiting a physician for simple conditions such as nausea, headaches, and allergies.

In an attempt to more fully understand or describe the characteristics of individuals who are more likely to practice self-care, researchers have examined health-related belief measures. One health belief measure is the Health Locus of Control (HLC), which has been used to determine the type of control one exhibits in their behavioral approach and decision-making on health-related issues. A person's HLC originates from an individual's perception regarding their health condition and their health behaviors. Individual perceptions include the level of self-esteem and self-awareness, how much importance is placed on their health, and the benefits of taking certain actions. Other factors such as age, demographics, income, and education can also affect how a person behaves and makes decisions concerning health-related issues.

The HLC identifies three main dimensions of perception. Although an individual may appear to exhibit all three perceptions at different times, one dimension of perception usually dominates the other two in decision making. The first HLC dimension is internal control. These individuals exhibit a strong sense of empowerment in their own health outcomes. Duffy found individuals with a strong dimension of internal control tend to be more proactive in applying what they believe to be a healthy lifestyle. The second HLC dimension is external control. These individuals generally rely on "powerful others" to make decisions concerning their health or recovery from illness. Duffy found these individuals to be passive and
compliant. Thus, they believe management of their health is beyond their personal control, and they rely on the provider to make decisions for them.\textsuperscript{36} Last, the chance HLC or fatalistic dimension perceives health as predetermined by bad luck, chance, or fate. Strategies used in this perception are usually prayers or lucky charms with little regard for professional advice.\textsuperscript{36,37}

Furnham and Smith,\textsuperscript{35} and Astin\textsuperscript{43} used a health belief measure to study behaviors among patients visiting a homeopath and patients visiting a general practitioner. These researchers reported that internal control and being proactive over their health decisions were important to herbal users, particularly to subjects in Furnham and Smith's study.\textsuperscript{35} Those who used herbal medicine generally sought methods that were aligned with their health belief and the belief that the body is capable of healing itself. At this time, no studies on herbal use by dental patients and health beliefs have been reported.

With an increasing number of people educating themselves and actively seeking unconventional remedies without involving their health care providers, the issue and concern of herbal use safety continues to intensify.\textsuperscript{1,2,4-7,11,38} The issue of quality control makes drug-herb interactions less predictable and possibly less recognizable for individuals who self-medicate and for their health care providers.\textsuperscript{39} Although most drug-herb interactions are not clearly understood, herbal remedies can increase, decrease, or inactivate the effectiveness of prescription drugs.\textsuperscript{4,39-42} For example, several studies found that St. John's wort greatly compromises the action of two prescription drugs, indinavir, an HIV protease inhibitor drug, and cyclosporin, an immunosuppressor drug used to prevent organ transplant rejection.\textsuperscript{29,40,42} The indinavir drug was quickly eliminated from the body by St. John's wort, whereas cyclosporin was inactivated.

**Methods and Materials**

The purposes of this study were: to describe the basic demographics and health belief differences between herb users and nonherb users; to address any potential drug-herb interactions; and to examine the association between dental chart noted and questionnaire self-reported use of herbal remedies in a dental setting.

A survey was developed to collect data regarding respondent demographics, prescription and/or herbal products used, and individual health belief systems. The clarity of the questionnaire was established using a convenience sample of 10 subjects at the University of Missouri-Kansas City (UMKC) dental clinic. Some questions were phrased to capture the same issue in both negative and positive statements to ensure reliability in interpretation and to gather information of patient knowledge of herbs. Results were used to improve item clarity in order to reduce error variance. The UMKC Institutional Review Board approved the survey and administration techniques.

The population studied was a convenience sample drawn from the dental school general clinic patient population and two private general dental practices. These sites were chosen because of their distinct differences in demographics according to age, ethnicity, education, and annual income. The sample group included 153 adult dental patients. A sample size of 150 subjects was determined to be sufficient to provide stable estimates for multivariate analyses.\textsuperscript{45} In the waiting room of each site, a single investigator approached each patient as they signed in to receive dental treatment and invited them to participate in the study. At each site, over a 2½ week data collection period, 51 dental patients completed a written survey questionnaire and seven declined to participate. In all, during a visit at one of the three sites, 153 individuals signed a consent form to participate and completed the written questionnaire, regardless of their herbal use.

After the subjects completed the written questionnaire, the investigator conducted a chart audit. At each site, the primary investigator used a standardized form to record the dental/medical history of each patient. All data was coded to maintain confidentiality.

Nonusers were defined as subjects who had not used herbal remedies in the past year. Herbal users were defined as subjects that were currently using or had used an herbal therapy or a combination of herbal therapies in the past year.

This study was comprised of two components: a 3-part questionnaire and a chart audit. The questionnaire covered two basic areas: (a) demographic information; (b) herbal and prescription drug use. A chart audit was used to determine if
updates on prescription, over-the-counter, and herbal medications were recorded in the permanent dental record, who updated the subject's medical history, subject's dental treatments, and any known allergies.

The written questionnaire was developed to elicit information on dental patients' herbal use, demographics (socioeconomic status, education, geographic region, age, gender, and health care status), and health belief locus of control. The first part of the questionnaire consisted of open-ended and closed-ended questions on demographic information, current prescription medication use, and for what condition the medication was being taken. The second part listed 37 specific herbal remedies in alphabetical order, 14 herbal combinations, and an "Other" column for any herbal remedies and combinations not listed. The third part consisted of 35 items to measure six subscales of health belief and patient attitudes toward herbs using a 5-point Likert scale (1=strongly agree, 5=strongly disagree). The six subscales of health belief seen in Table I are as follows: 1) Internal Locus of Control (LOC)-8 items; 2) External LOC-8 items; 3) Chance LOC-6 items; 4) Health Threat LOC-4 items; 5) Effectiveness LOC-2 items; and 6) Disclosure LOC-4 items. Three additional items were also included to measure the perception of health status, herbal safety, and prescription drug safety.
Survey items in the third part of the questionnaire were adapted from three different sources. Eight items on safety, effectiveness, and patient disclosure belief were taken from Klepser.\textsuperscript{14} One item was taken from a study by Astin\textsuperscript{43} investigating possible predictors of alternative health care use. The item was used in this study to describe patients' perceived level of health status. Twenty-six items were used from Lau and Ware's research on the construct of the health belief model.\textsuperscript{34} Results from their analysis ascertained four distinct health-specific loci of control subscales (internal, external, chance, and health threat).

### Table I. Six Health Loci of Control Subscales and Health Status and Herbal and Prescription Safety Items

<table>
<thead>
<tr>
<th>Locus of Control</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Locus of Control (*)</td>
<td>1) I believe self-care is unrelated to stress.</td>
</tr>
<tr>
<td></td>
<td>2) I believe people who perform self-care stay healthy.</td>
</tr>
<tr>
<td></td>
<td>3) I believe people can't prevent illness.</td>
</tr>
<tr>
<td></td>
<td>4) I believe people can't do much when sick.</td>
</tr>
<tr>
<td></td>
<td>5) I believe anyone can learn prevention.</td>
</tr>
<tr>
<td></td>
<td>6) I believe poor health is due to carelessness.</td>
</tr>
<tr>
<td></td>
<td>7) I believe confidence contributes in the ability to cure oneself.</td>
</tr>
<tr>
<td></td>
<td>8) I believe getting sick is your own fault.</td>
</tr>
<tr>
<td>External Locus of Control (*)</td>
<td>1) I believe doctors help patients feel better.</td>
</tr>
<tr>
<td></td>
<td>2) I believe recovery requires medical care.</td>
</tr>
<tr>
<td></td>
<td>3) I believe check-ups with physician help to stay healthy.</td>
</tr>
<tr>
<td></td>
<td>4) I believe people are helped a great deal by doctors in staying healthy.</td>
</tr>
<tr>
<td></td>
<td>5) I believe doctors don't help patients.</td>
</tr>
<tr>
<td></td>
<td>6) I believe doctors relieve/cure few problems.</td>
</tr>
<tr>
<td></td>
<td>7) I believe doctors rarely help sick people.</td>
</tr>
<tr>
<td></td>
<td>8) I believe doctors do little to prevent illness.</td>
</tr>
<tr>
<td>Chance Locus of Control (*)</td>
<td>1) I believe good health is a matter of luck.</td>
</tr>
<tr>
<td></td>
<td>2) I believe getting well is related to chance.</td>
</tr>
<tr>
<td></td>
<td>3) I believe lucky people don't get sick.</td>
</tr>
<tr>
<td></td>
<td>4) I believe staying well is unrelated to chance.</td>
</tr>
<tr>
<td></td>
<td>5) I believe health requires no bad luck.</td>
</tr>
<tr>
<td></td>
<td>6) I believe recovery is unrelated to luck.</td>
</tr>
<tr>
<td>Health Threat</td>
<td>1) I believe nothing can be done for some illness</td>
</tr>
<tr>
<td></td>
<td>2) I believe seriousness of disease is overstated.</td>
</tr>
<tr>
<td></td>
<td>3) I believe some diseases just wipe you out.</td>
</tr>
<tr>
<td></td>
<td>4) I believe some problems are serious or fatal.</td>
</tr>
<tr>
<td>Effectiveness (*)</td>
<td>1) I believe that herbal therapies improve my health.</td>
</tr>
<tr>
<td></td>
<td>2) Members of my family believe that herbal therapies can improve my health.</td>
</tr>
<tr>
<td>Disclosure(*)</td>
<td>1) My physician should be aware of my use of herbal therapies.</td>
</tr>
<tr>
<td></td>
<td>2) My dental practitioners should be aware of my use of herbal therapies.</td>
</tr>
<tr>
<td></td>
<td>3) If asked about drugs, I would tell my physician about my herbal use.</td>
</tr>
<tr>
<td></td>
<td>4) If asked about drugs, I would tell my dental practitioner about my herbal use.</td>
</tr>
<tr>
<td>Health Status(*)</td>
<td>1) Would you say that your health in general is</td>
</tr>
<tr>
<td>Safety (*)</td>
<td>1) Herbal therapies are safe for me to take.</td>
</tr>
<tr>
<td></td>
<td>2) Prescription drugs are safe for me to take.</td>
</tr>
</tbody>
</table>

* Items used in the analysis
This study set out to extend previous work by looking at dental patients and herbal use. Hypotheses of this study are as follows:

There will be a difference between herbal users and nonherbal users with respect to demographics (education, economics, race, gender, and age) and health belief system as measured by health locus of control items (internal, external, and chance control);

There will be potential herb-drug interactions among herb users using prescription drugs; and that

There will be a difference between dental chart noted and questionnaire self-reported use of herbal remedies as measured by comparing written documentation in the health history form to survey questionnaire.

Data from this study were analyzed in the following manner. Chi-square analysis (i.e., comparing observed frequencies to expected frequencies) was used to examine the association between self-reported use by the written questionnaire and self-reported use of herbs as determined by the written medical history from the chart audit. Differences between herbal users and nonusers with respect to demographics: gender, age, ethnicity, education, income, and health belief system were compared using chi-square analysis.

The MANOVA statistical test was used to compare herbal users and nonusers across subscale scores. The relationship between a patient’s self perceived health status and the use or the nonuse of herbs was examined using the Mann-Whitney U statistical test.

**Results**

Of the 153 surveys obtained from dental patients at three dental treatment sites, 149 (97%) were used for analysis. Four subjects were removed due to unavailability of charts for conducting the chart audit and one subject also did not complete the survey because of shortage of time before the appointment.

Fifty-three percent of the sample identified themselves as herbal users (Table II). There was a significant difference in gender (p < .001) among herb users with the use of herbs significantly higher among women (71%) compared to men (29%). Additional analyses detected no differences between herbal users and nonusers with respect to the remaining demographic data collected: age, ethnicity, education, region, and income.
One of the primary purposes of this study was to characterize herbal users and nonusers as a function of health belief system. Internal consistency estimates of reliability (Cronbach's a) were calculated for each of the defined subscales. Effectiveness, External Locus of Control and Patient Disclosure subscales had acceptable reliability coefficients (a = .67; .77; .78, respectively). Therefore, all items in these original subscales were maintained. Analysis of the remaining subscales showed some items did not contribute to the scales' internal consistency as shown in Table III. Consequently, items were deleted from subscales Internal Locus of Control (LOC) and Chance LOC to increase the reliability coefficient (Table I). The Health Threat LOC had a reliability coefficient of -0.07 for the original items and did not show consistency among any items. This subscale was omitted from subsequent analyses.

MANOVA was conducted to examine differences across health belief subscales as a function of herbal use. There was a statistically significant difference across health belief subscales (Hotellings T = .347, p= .0001) as seen in Table IV. The
overall $\eta^2$ of .26 suggests that there was a large meaningful difference across subscales means of herbal users and nonusers in overall beliefs. To determine the mean for each subscale, the negative items from the Likert scale were inverted to be positive items. Then each reported score in the subscale was added and divided by the total number of items. Univariate follow-up analyses were used to examine health beliefs by subscales between herbal users and nonusers. These analyses showed that the subscale Herb Effectiveness largely influenced the overall differences between groups. The herb user group had a lower mean on the effectiveness subscale (4.7; sd 1.5) than the nonuser group (6.0; sd 1.2), illustrating a stronger belief in the effectiveness of herbs in improving their health ($p < .0001$, $\eta^2 = .20$). No differences were found between users and nonusers with respect to Internal LOC, External LOC, Chance LOC, and Patient Disclosure subscales.

<table>
<thead>
<tr>
<th>Subscale (number of items used)</th>
<th>Herbal user Mean (sd)</th>
<th>Nonuser Mean (sd)</th>
<th>Range of Scores</th>
<th>(p-value)</th>
<th>($\eta^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness Subscale (2)</td>
<td>4.7 (1.5)</td>
<td>6.0 (1.2)</td>
<td>(2.0-10.0)</td>
<td>0.00*</td>
<td>0.20</td>
</tr>
<tr>
<td>Internal Locus of Control Subscale (4)</td>
<td>11.8 (1.8)</td>
<td>12.1 (1.9)</td>
<td>(4.0-20.0)</td>
<td>0.37</td>
<td>0.01</td>
</tr>
<tr>
<td>External Locus of Control Subscale (8)</td>
<td>25.5 (2.9)</td>
<td>25.6 (2.5)</td>
<td>(8.0-40.0)</td>
<td>0.91</td>
<td>0.00</td>
</tr>
<tr>
<td>Chance Locus of Control Subscale (3)</td>
<td>12.6 (1.8)</td>
<td>12.3 (2.2)</td>
<td>(3.0-15.0)</td>
<td>0.36</td>
<td>0.01</td>
</tr>
<tr>
<td>Disclosure Subscale (4)</td>
<td>7.6 (2.5)</td>
<td>7.0 (2.2)</td>
<td>(4.0-20.0)</td>
<td>0.12</td>
<td>0.02</td>
</tr>
<tr>
<td>Overall score</td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
<td></td>
</tr>
</tbody>
</table>

1 = Strongly agree; 2 = Agree; 3 = No opinion; 4 = Disagree; 5 = Strongly disagree
* Statistically significant ($p < .05$)

A logistic model was subsequently fitted with herbal use modeled as a function of seven selected predictor variables to produce odds ratios. Table V presents the $b$ weights, standard error, significance, and odds ratio with 95% CI for the final logistic model. The results supported gender ($p \leq .001$), herb effectiveness ($p \leq .001$), and patient disclosure ($p \leq .005$) as significant predictors of herbal use.

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>$b$ Weights</th>
<th>S.E.</th>
<th>Sig.</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-1.53</td>
<td>.49</td>
<td>0.001*</td>
<td>4.67 (1.80, 12.40)</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>-.98</td>
<td>.26</td>
<td>0.001*</td>
<td>2.56 (1.60, 4.40)</td>
</tr>
<tr>
<td>Disclosure</td>
<td>.30</td>
<td>.11</td>
<td>0.005*</td>
<td>0.73 (0.59, 0.91)</td>
</tr>
<tr>
<td>Internal Locus of Control</td>
<td>.02</td>
<td>.12</td>
<td>0.89</td>
<td>1.02 (0.80, 1.30)</td>
</tr>
<tr>
<td>External Locus of Control</td>
<td>.15</td>
<td>.10</td>
<td>0.15</td>
<td>1.16 (0.95, 1.41)</td>
</tr>
<tr>
<td>Chance Locus of Control</td>
<td>-.05</td>
<td>.13</td>
<td>0.74</td>
<td>0.96 (0.74, 1.24)</td>
</tr>
<tr>
<td>Health Status Perception</td>
<td>-.11</td>
<td>.26</td>
<td>0.69</td>
<td>0.90 (0.54,1.50)</td>
</tr>
<tr>
<td>Constant Value</td>
<td>2.11</td>
<td>2.98</td>
<td>0.48</td>
<td>8.24</td>
</tr>
</tbody>
</table>

* Statistically significant, $p < .05$
The odds of females using herbal remedies were 4.67 times greater than for males (95% CI = 1.80, 12.40). In this study, 71% of herbal users were females compared with 29% males. The odds of herbal use were 2.56 times greater for each increase in score level unit for those who believed in herbal effectiveness (95% CI = 1.60, 4.40). Sixty percent of herbal users believed that herbs do improve overall health compared to only 12% of nonusers. In addition, 59% of herbal user respondents believe family members agree that herbs improve health compared to 20% of nonusers. Finally, the odds of patients' willingness to disclose herbal use to health practitioners were significantly less for users than nonusers (OR = 0.73; CI= 0.59, 0.91). The findings revealed only 3 of the 80 herb users (3.8%) reporting use of herbals actually had documentation of their herbal use in their dental record (Table VI). This difference was statistically significant ($X^2 = 68.45$, $p \leq .001$).

### Table VI. Self-Reported Versus Documentation of Herb Use in Dental Record Among Herb Users

<table>
<thead>
<tr>
<th></th>
<th>n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herb users with no documentation of herbal usage in dental record.</td>
<td>77 (96.2)</td>
</tr>
<tr>
<td>Herb users with documentation of herbal usage in dental record.</td>
<td>3 (3.8)</td>
</tr>
</tbody>
</table>

$\text{p} \leq .001$

This study identified five herbs most frequently used: echinacea, ginseng, garlic, ginkgo biloba, and St. John's wort, respectively. Table VII documents the number of potential herb-drug interactions of the herbal users. Of the 88 herbal users, 55 were also taking prescription drugs. A total of 24 various potential herb-drug interactions were recorded. Subjects taking echinacea were also taking prescription medications that were not contraindicated with the herbs. Likewise, subjects taking synthroid and gastrointestinal drug therapies were taking herb remedies that were not contraindicated.
Discussion

The focus of this study was to describe basic demographics and health belief differences between herb users and nonherb users, to address any potential herb-drug interactions, and to examine the association between dental chart noted and questionnaire self-reported use of herbal remedies. One of the most significant findings of this study was the lack of documentation in the dental record compared to self-reported herbal use as reported by study participants in the written survey. Chart audits revealed that more than 96% of herbal users did not have any written documentation of herbal use in their dental chart. These findings are similar to the findings reported from several other studies.\(^3,5,11,14\)

When study participants were asked whether physicians and dental practitioners should be made aware of the use of herbal therapies, a majority responded positively. However, less than 4% had documentation of their herbal use in their dental chart. The discrepancy between the lack of documentation and the willingness to disclose the use of herbs may be due to several reasons identified by this study and previous studies.

First may be the perception of patients that herbal remedies may not be considered medications.\(^4,10,21,28\) It is possible that herbal users view herbal remedies like over-the-counter dietary supplements and vitamins. Most medical histories do not separate traditional prescription medicine from alternative medicine. If this is the case, voluntarily disclosing herb use to healthcare practitioners may not seem relevant to herb users. Also, researchers have hypothesized that a lack of trust between the patient and their provider could cause the patient to feel uncomfortable in disclosing their use of herbals.\(^3,7,9,11,23,31\)

If the patient perceives disapproval from healthcare providers about their use of herbs, the patient becomes less likely to disclose using them. In this study, the written questionnaire specifically asked the patient to disclose any herbs being presently taken, and that may be one reason for the large number of herbal use disclosures in the surveys compared to their medical charts. Patients may be more willing to disclose the use of herbs if asked directly by their healthcare practitioner. However, this study did not ask the provider if they asked patients about herbal use during the medical history review or updates.

### Table VII. Possible Herb/Prescription Drug Interactions Among Herbal Users

<table>
<thead>
<tr>
<th>Herbal Group</th>
<th>Prescription Drug Group</th>
<th>Number of herb users with potential herb/drug interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginseng</td>
<td>Cardiovascular therapy</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hormone therapy</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Analgesic therapy</td>
<td>3</td>
</tr>
<tr>
<td>Garlic</td>
<td>Anticholesterol therapy</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Analgesic therapy</td>
<td>2</td>
</tr>
<tr>
<td>Gingko biloba</td>
<td>Cardiovascular therapy</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Antidepressant therapy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Analgesic therapy</td>
<td>2</td>
</tr>
<tr>
<td>St John’s wort</td>
<td>Cardiovascular therapy</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Antidepressant therapy</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hormone therapy</td>
<td>1</td>
</tr>
</tbody>
</table>
Regarding differences between groups with respect to demographics and health belief system, the only demographic variable that was significant was gender, with women reporting higher use of herbals than men. This finding supports several studies that reported women as more likely than men to use herbal remedies. Traditionally, women tend to be greater health seekers than men, so it is not surprising to find women more willing to try herbal remedies. Interestingly, in this study two male subjects commented that they were not sure why they were taking herbal remedies, but that their wives included them into their daily regimen along with their prescription or vitamin therapy. These results seem to support the theory that women are more likely to be herbal users and look for preventive therapies.

The seven predictors: Internal LOC, External LOC, Chance LOC, health status, herb effectiveness, herb disclosure, and safety of herbs and prescriptions used in this study had been previously identified as predictors of herbal use by other investigators, however study results were mixed. Results from this study, along with Vincent and Furnham (1996), Eisenberg et al (1998), Klepser et al (2000), and Palinkas and Kabongo (2000), found gender, herbal effectiveness, and herbal disclosure to be good predictors of herbal use. However, Furnham and Forey (1994), Eisenberg et al (1993), and Astin (1998) did not. With the remaining predictors, evidence for whether or not health belief loci of controls and health status perception predict herb users was also found to be equivocal.

Reasons for no differences between the herb users and nonherb users health belief loci of controls are difficult to ascertain in the current study. Future studies might include a personal interview that could help the researcher extrapolate greater information about health belief loci of control in both groups.

Perhaps health behavior is more complex and in-depth and intertwines with certain cultural beliefs that these questions on health behaviors are not capable of fully explaining. It would seem that predicting use of herbals is multifaceted, which is why the results are mixed among studies. Further studies are needed to identify additional predictors of herbal use.

Another finding of particular interest in this study was the potential for adverse associations between herbals and/or drugs and certain dental procedures. Results from this study showed that 54 herbal users (68%) were scheduled to receive some sort of invasive dental treatment (restorations, periodontal surgery and maintenance, root canals, and tooth extractions) with many of these treatments requiring the use of local anesthetic. Because many of these dental treatments involve bleeding, herbal use such as gingko biloba, garlic, and ginseng should be of concern to the practitioner due to their potential for causing excessive bleeding. Although, no research has actually examined the interaction of local anesthetic and herbal remedies, warnings related to potential interactions between general anesthetic agents and herbal remedies have been explicit. The American Society of Anesthesiologists (2000) issued a warning in 1999 on the risk for herb-anesthesia interactions for surgery patients and the importance of including herbal remedies as part of the medical history. Herbal remedies such as valerian, ginseng, gingko biloba, and several others have been known to interfere or increase effects of anesthesia as well as complicate preoperative preparations to surgery.

Potential herb-drug interactions for study participants are shown in Figure 1. Results from this study revealed that 55 study participants, more than half of those using herbal remedies, were also using prescription drugs (69%). Because this study only examined the five most commonly used herbals and five most commonly used prescription groups, the potential for interactions was limited to these herbals and prescription drug groups. With the exception of the herb echinacea, there were potential herb-drug interactions with the following herbs: ginseng, garlic, gingko biloba, and St. John's wort. These herbs have potential interactions mostly with cardiovascular and analgesic therapies. Participants in this study taking antiarrhythmia, antihypertension, diuretics, beta-blockers, anticoagulant, and calcium channel blockers medications were categorized as using Cardiovascular therapy. Cardiovascular drugs, when used with ginseng, gingko biloba, and St. John's wort, have been reported to increase antiplatelet effects, exacerbate effects, or augment and decrease effects of certain medications. Participants taking non-steroidal anti-inflammatory drugs (NSAIDS) and aspirin were categorized as using analgesic therapy. Concomitant use of analgesic therapies with herbs such as ginseng, garlic, or gingko biloba have been shown to increase antiplatelet effects and cause further damage to the gastrointestinal area. Other potential drug interactions of concern in this study were concomitant use of antidepressants with St. John's wort or gingko biloba. Interactions include increased sedation effects and possible decrease of threshold with certain antidepressants used in treating patients for seizures.
Certain limitations of this study must be acknowledged when the implications of study results are considered. The generalizability of the results in this study is limited by the small sample size and the fact that participants were from a single metropolitan area. In addition, the potential for bias, as a result of the self-report survey design, also must be considered in interpreting the results.

Further studies are needed to examine other potential predictors of herbal use such as religion and spiritual beliefs. Personal interviews may be a way to extrapolate additional information as well as clarify ambiguity with health-specific loci of controls. Soliciting information from herbal users on actual reactions and side effects would help practitioners and patients gain a better understanding of how herbal usage impacts the body. Changes in the work environment such as asking clients of any herbal use and documenting its use may contribute to greater information on behaviors of herbal users as well as assessing the information for potential adverse affects and reactions.

**Conclusion**

The survey findings do provide and contribute a better understanding of those who use herbs, specifically within a dental practice setting. Understanding behaviors and characteristics of those who are likely to use herbs is essential for recording and maintaining comprehensive health histories. In an era when so many people are self-diagnosing and self-medicating, it is the healthcare practitioner’s responsibility to help patients become better informed to make safe and appropriate health related choices. Finding out the kind and reasons for herbal use will help dental hygiene practitioners inform patients of any possible harmful interactions that they may not be aware of while supporting individuals in their beliefs and attitudes about herbs. Dental hygienists should provide dental patients with information of potential drug-herb interaction, adverse reactions, and side effects especially with those requiring tooth extraction, periodontal surgery, and other complex dental treatments where bleeding and anesthetics are a concern.
To treat the new population of self-medicating patients, healthcare professionals need to be open and receptive to patients’ health-related beliefs. By communicating and asking patients whether they use herbal remedies, practitioners can then responsibly advise or inform patients of potential interactions involving their dental treatment or drug-herb interactions.

Acknowledgements

Supported in part from funding from the University of Missouri-Kansas School of Dentistry Rinehart Foundation

Notes

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References

Sulcular Sulfide Monitoring: An Indicator of Early Dental Plaque-Induced Gingival Disease

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Purpose. The purpose of this study was to evaluate the relationship between volatile sulfur compounds (VSC) and gingival health status and to determine if volatile sulfur compounds can detect early dental plaque-induced gingival disease.

Methods. A split-mouth design with randomly selected quadrants of the mandibular arch enabled 39 participants to serve as their own controls. At baseline and at three subsequent appointments (days 7, 14, and 21) gingival inflammation (GI), bleeding on probing (BOP), and sulfide levels (SUL) were measured using the Gingival Index and the Diamond Probe/Perio 2000 System. For three weeks, participants refrained from brushing and flossing one randomly selected quadrant of the mandibular arch. The Pearson correlation test was used to determine the relationship between sulfide concentrations and gingival health. The Wilcoxon signed rank test was used to compare the differences in mean GI, BOP, and SUL scores between the hygiene side (H) and the non-hygiene side (NH).

Results. Data suggest that SUL correlate positively to GI and BOP on both sides; however, the strength of the correlation was stronger for the NH side. A comparison of mean GI, BOP, and SUL scores revealed a statistically significant difference between sides for all three parameters from baseline to day 21, except for SUL on day 14.

Conclusions. Based on study outcomes, the Diamond Probe/Perio 2000 System demonstrated the ability to detect sites with elevated SUL; therefore, SUL may be a useful adjunctive indicator of early plaque-induced gingivitis. In addition, data revealed a moderate correlation between SUL levels and gingival inflammation on the NH sides. Whether sulfur by-product is a contributor to the disease process, or merely a correlate, is inconclusive.

Keywords: gingivitis, volatile sulfur compounds, Diamond Probe/Perio System

Introduction

Periodontal disease includes a group of inflammatory conditions of the periodontal tissues broadly categorized as gingivitis and periodontitis. Inflammation of the gingiva induced by plaque biofilm is the most common form of gingivitis. Experimental research in humans has long confirmed bacterial plaque as a cause of gingival disease. Moreover, the
American Academy of Periodontology supports the theory that the initiation and progression of most forms of gingivitis are dependent upon the presence and persistence of specific pathogens in bacterial plaque. As gram-negative bacteria cross the epithelial barrier into the underlying connective tissue of the periodontium, an inflammatory reaction in the host is initiated, leading to connective tissue breakdown. Gram-negative bacteria have the potential to generate volatile sulfur compounds (VSC), specifically, hydrogen sulfide (H₂S), methyl mercaptan (CH₃SH), and dimethyl sulfide (CH₃SCH₃), as by-products of their metabolism. These by-products of bacterial metabolism may be factors in the etiology and pathogenesis of periodontal disease.

Numerous studies reveal that sulfur by-products are associated with periodontal disease. Additionally, researchers suggest that even in low concentrations, VSC are highly toxic to periodontal tissue and may contribute to the etiology of gingivitis. Tonzetich proposed that VSC might alter the permeability of affected cells and facilitate the transmission of toxic metabolites into underlying connective tissue, which contributes to the progression of periodontal disease. Yaegaki and Suetaka found that concentrations of VSC precursors increased with the severity of periodontal disease. The ratio of CH₃SH and H₂S significantly increased in patients with periodontal disease in proportion to bleeding and probing depth. The amounts of H₂S and CH₃SH in infected periodontal pockets were considered high; however, the validity of VSC as an indicator of plaque-induced gingivitis and its relationship to oral health is still unknown.

As plaque bacteria and bacterial by-products interact with the host, inflammation and tissue destruction results, leading to the clinical signs and symptoms of gingivitis. Gingivitis is a necessary precursor to the development of periodontitis; however, not all gingivitis progresses to periodontitis. In an attempt to develop objective measures of disease activity, studies have tested saliva, blood, plaque, and gingival crevicular fluid (GCF). Bleeding, a classic sign of inflammation, and periodontal probing have long been used as standard measures of disease activity. Bleeding on probing (BOP) and the Gingival Index (GI) have been used to clinically characterize the degree of clinical gingival inflammation; however, it is becoming increasingly apparent that traditional clinical criteria are inadequate for determining active disease sites, quantitatively monitoring the response to therapy, and/or measuring the degree of susceptibility to future breakdown. For many years, researchers have sought refinements in the sampling of blood, saliva, plaque and GCF. The availability of more analytical techniques for detecting disease-associated bacteria in subgingival plaque gives significant cause for optimism.

Since research suggests a correlation between sulfides and plaque-induced gingivitis, the presence of sulfides in the gingival sulcus should alert the clinician to the possibility of disease activity. The cytotoxicity of H₂S and CH₃SH strongly suggests that VSC may play an etiologic role in the gingival disease process since both H₂S and CH₃SH are capable of inducing a change in the structure of the crevicular epithelium and initiating the destructive inflammatory process. Rizzo indicated that detectable hydrogen sulfide is produced in the deepest portion of periodontal pockets in humans; therefore, detecting the presence or absence of VSC within the periodontal pockets could be a direct measure of the gram-negative bacterial activity.

The Diamond Probe/Perio 2000 System is a device that measures sulfide levels as an adjunct to traditional diagnostic techniques in the evaluation of periodontal disease. Standard periodontal probing is a retrospective analysis of disease, whereas the Diamond Probe/Perio 2000 System provides a real-time indicator of sulfide activity. The system reduces uncertainty about the presence of gram-negative bacterial activity in the gingival sulci by detecting various forms of sulfides (S⁻, HS⁻, H₂S, and CH₃SH). The presence of relative sulfide concentrations in individual sulcus sites alerts the practitioner to the presence of bacterial activity, therefore improving clinical decision-making in periodontal assessment.

Review of the Literature

Researchers have studied VSC as intermediate products from the bacterial putrefaction of proteins with sulfur-containing amino acids and other proteins in the human oral cavity. Studies have demonstrated that H₂S and CH₃SH are predominant
components of VSC. Additional studies have been conducted to determine whether or not H\textsubscript{2}S and CH\textsubscript{3}SH gases actually do cause significant tissue destruction in the oral cavity.

Research suggests that the presence of SUL in healthy people may be influenced by individual differences, the aging of the plaque in the absence of oral hygiene procedures for 24 hours prior to data collection, and absorption from the diet. This observation is supported by the work of Yaegaki and Sanada, who found that VSC concentrations were higher in mouth air from individuals with BOP than those with no BOP.

Upon observing an increased volume of VSC in the oral cavity of individuals with periodontal disease, Rizzo pointed out that H\textsubscript{2}S is one of the most toxic metabolic by-products of anaerobic bacteria located in periodontal pockets. In the oral cavity, the frequency of anaerobic bacteria increases in periodontitis as compared with healthy sites. Langendijk, et al determined that periodontal sulfate-reducing bacteria are associated with several clinical categories of periodontitis and with periodontal sites of increased pocket depth. Toxic sulfide products of these strictly anaerobic bacteria can accumulate in periodontal pockets in concentrations that may cause cellular destruction. Ng and Tonzetich suggested that H\textsubscript{2}S adversely affects protein synthesis of human gingival fibroblasts in culture. Upon exposure of collagen to elevated H\textsubscript{2}S concentrations, the H\textsubscript{2}S converted some acid-soluble collagen to a more soluble product. This effect on collagen solubility makes it more susceptible to enzymatic degradation and contributes to the increased destruction of collagen observed in thiole-treated fibroblast cultures.

Tonzetich and McBride observed differences in intermediate sulfide metabolism between non-pathogenic strains of \textit{Bacteroides melaninogenicus var melaninogenicus} (CP-) and pathogenic \textit{Bacteroides melaninogenicus} (CP+). The CP+ strains, which produced collagenase and protease and caused the formation of abscesses when injected subcutaneously into the groins of guinea pigs, produced copious amounts of VSC, which consisted predominantly of CH\textsubscript{3}SH. Although the CP- organisms did not grow as well as the CP+, the differences in concentration of VSC may be only partly related to the disparity in growth rates. Results suggest that VSC analysis offers a convenient means of assessing strain differences and pathogenic potential of \textit{Bacteroides melaninogenicus}. The addition of glucose to the medium depressed total volatile sulphur production by both CP+ and CP- strains, attributable mostly to lower H\textsubscript{2}S levels.

Persson et al reported that subgingival microbiotas recovered in deep periodontal pockets had a very high capacity to produce VSC in human serum. Bacterial samples taken from 7mm to 12mm periodontal pockets were incubated for seven days to determine the amount of VSC and the degradation of serum protein produced. Results suggest that H\textsubscript{2}S was the predominant VSC in the serum, but significant amounts of CH\textsubscript{3}SH also formed. In addition, members of subgingival microbiotas had the capacity to degrade human serum proteins and form VSC compounds.

Persson revealed that the most potent producers of H\textsubscript{2}S were \textit{Trepomena denticola} and black-pigmented species, \textit{Bacteroides intermedius}, \textit{Bacteroides loescheii}, \textit{Porphyromonas endodontalis}, and \textit{Porphyromonas gingivalis}. \textit{Porphyromonas gingivalis} also produced copious amounts of CH\textsubscript{3}SH in serum protein, suggesting that VSC initiate and perpetuate an inflammatory response, producing tissue irritation, bleeding, and increase of susceptibility to periodontal breakdown in the future.

Researchers have established a direct correlation between the amounts of H\textsubscript{2}S and CH\textsubscript{3}SH and the severity of periodontal disease activity. By using radioactive, electrophoretic, and chromatographic techniques, Tonzetich and Lo observed the reactions of H\textsubscript{2}S within saliva, collagen, and gelatin. The exposure of oral mucosa to both H\textsubscript{2}S and CH\textsubscript{3}SH caused a marked increase in its permeability. These findings support the involvement of sulfide compounds in the etiology of periodontal disease. Since H\textsubscript{2}S has been identified in periodontal pockets and is implicated in periodontal disease, results of the H\textsubscript{2}S treatment of collagen and saliva could provide insight into the possible mechanism of involvement in the disease process.

Periodontal pockets are believed to be one of the main production sites of oral VSC. The generation of H\textsubscript{2}S and CH\textsubscript{3}SH could be due to the presence of the specific gram-negative organisms in gingival crevicular fluid (GCF) or the effect of
enzymes produced by organisms in the fluid. The clinical presentation of gingivitis is important because of the association of elevated sulfide levels and disease; therefore, the adjunctive use of VSC monitoring is promising.

Methods and Materials

Thirty-nine individuals, between ages 19 and 62, who were in good general health, not pregnant, free of orthodontic and prosthetic appliances, had a Gingival Index score of 0 to 1, and were free of antibiotics for one month prior to data collection were enrolled. Among the 39 participants, 28 (71.79%) were women and 11 (28.21%) were men with a mean group age of 25.67 years. The informed consent approved by the Institutional Review Board of Old Dominion University was signed in duplicate, with one copy given to the individual and one copy placed on file. Participants were recruited via flyers distributed throughout the university community and campus wide e-mail system. A single dental hygienist was calibrated for intra-rater reliability prior to data collection.

Each participant’s mandibular arch was randomized to hygiene (H) and non-hygiene (NH) sides to allow each individual to serve as his/her own control. At baseline, all participants were given the same type of soft toothbrush and fluoride toothpaste without added ingredients for controlling gingivitis or calculus formation (Crest Regular Sodium Fluoride Toothpaste. Procter and Gamble, Cincinnati, OH). No attempt was made to modify participants’ daily oral hygiene except on the NH side where individuals were advised to refrain from oral care for 21 days. Participants were instructed not to use mouth rinse for the duration of the study.

A full mouth (excluding third molars) periodontal probing was performed at four sites (distofacial, facial, mesiofacial, and midlingual) to determine baseline periodontal health status. GI, BOP, and SUL scores were obtained at the same four sites at baseline and three subsequent data collection appointments over a 21-day period (days 7, 14, and 21). At the completion of the study, all participants were offered a prophylaxis and were followed to ensure their return to baseline gingival health status.

The Diamond Probe/Perio 2000 System is a real-time, chairside system designed to evaluate relative gram-negative bacteria in the gingival sulci and periodontal pockets (Figure 1). When sulfides are encountered in the GCF, the system provides information three ways: through a lighted display, by emitting an audible tone, and by providing quantitative sulfide levels.

Diamond Probe Sensor Tip® incorporates a micro-sulfide sensor into a modified “Michigan O” style disposable periodontal probe to measure probing depth, BOP, while detecting the presence of sulfides (Figure 2). The thin, rounded probe tip has
incremental color-coded markings at 3, 6, 8, and 11 mm for easy measurement. The tip diameter of the Diamond Probe is 0.38 mm, which is the same diameter as the "Michigan O" probe.

Various forms of sulfides (S\(^-\), HS\(^-\), H\(_2\)S, and CH\(_3\)SH) within the GCF interact with the sensor tip of the probe and generate a signal that is converted to visual and audible alerts. The sensor tip is sensitive to one part per million molar sulfide (10\(^6\) mol. S\(^-\)). The digital format displays a measurement of sulfides ranging from 0 to 10,000 units quantified in increments of 0.5. Additionally, an analog display provides a four-color light bar that scales up and down to correlate with sulfide concentrations—from green (low) to red (very high)—along with an audible tone. The Diamond Probe/Perio 2000 System was used according to the manufacturer's directions.

Each of the four gingival areas (distofacial, facial, mesiofacial, and midlingual) were assigned a GI score from 0 to 3.

0=Normal gingival status
1= Mild inflammation—slight color change, slight edema. No bleeding on probing.
2= Moderate inflammation—redness, edema, and glazing. Bleeding on probing.
3= Severe inflammation—marked redness and edema, ulceration. Spontaneous bleeding.

BOP was additionally recorded as 0 (negative) or 1 (positive)

If SUL were detected, the probe tip was removed from the sulcus, washed to remove residual sulfides, and reset for the next measurement. After completing the examination of the lingual or buccal sections of a quadrant, even without SUL or BOP present, the probe tip was re-washed. This procedure was repeated when plaque from the sulcus was visible on the probe tip.
Results

The present study evaluated the relationship of sulfides and early dental plaque-induced gingivitis. Subsequent statistical analyses were conducted on average mean scores using individual teeth as the observation (or data). Data were analyzed using the mean as the most common measure of central tendency, percentiles describing the relative position of a given score in relation to other scores. The Pearson correlation test was used to determine the relationship between SUL, BOP, and GI. The Wilcoxon signed rank test was used to compare the differences in mean scores in GI, BOP, and SUL between H and NH sides. Since no multivariate nonparametric tests were readily available for application, testing was performed for GI, BOP, and SUL separately using the Wilcoxon signed rank statistic at the .05 level. To perform four comparisons for each GI, BOP, and SUL, a Bonferroni method of multiple comparisons will have a component-wise level of significance at the 0.0125 level. Even at the p=.01 significance level, most of the conclusions remain valid.

Overall mean scores of the GI, BOP, and SUL levels are presented in Table I. Visual comparisons of mean scores are presented in Figures 3, 4, and 5. Mean GI, BOP, and SUL scores on the NH side remained higher than on the H side throughout the study. GI scores on the NH side increased significantly from baseline to day 7, and then continued to increase, peaking at day 21; whereas, GI scores on the H side remained relatively stable, increasing slightly from baseline to day 21, but lagging significantly behind the NH side throughout the study (Figure 3). BOP scores on the NH side steadily rose from baseline to day 14, and then rapidly increased until day 21; whereas, the H side revealed no significant changes in BOP between baseline and day 7, a slight increase from day 7 to day 14, then a slight decrease to day 21 (Figure 4). SUL concentrations remained higher on the NH side throughout the study. SUL on the NH side, slowly increased from baseline until day 7, continued to rise until day 14, then rapidly increased until day 21; whereas, SUL on H side remained steady from the baseline to day 7, slightly increased between day 7 and 14, then continued to increase until day 21, but lagged significantly behind scores on NH side (Figure 5).
A comparison of the difference in mean scores of GI, BOP, and SUL are revealed in Table II. The Wilcoxon signed rank test statistics (d) for testing the significance of the difference in mean scores and the p-values are provided. Results suggest a significant difference in GI scores between sides (p < .0001, p = .0001, p = .0001) and BOP scores (p = .011, p = .006, p = .0001) at days 7, 14, and 21, suggesting that with the progression of disease, gingival inflammation, and bleeding increased significantly on the NH side. Data revealed a significant difference in SUL scores between sides at day 7 and 21 (p=0.026, p= < .0001); however, at day 14, there was no significant difference (p = .053).

### Table I. Overall Mean Scores of GI, BOP and SUL on Hygiene Side (H) and Non-hygiene Side (NH)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Side</th>
<th>Baseline</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>GI</td>
<td>H</td>
<td>0.15</td>
<td>0.21</td>
<td>0.17</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>NH</td>
<td>0.10</td>
<td>0.16</td>
<td>0.53</td>
<td>0.31</td>
</tr>
<tr>
<td>BOP</td>
<td>H</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>NH</td>
<td>0.06</td>
<td>0.10</td>
<td>0.11</td>
<td>0.14</td>
</tr>
<tr>
<td>SUL</td>
<td>H</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>NH</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

N = 39

### Table II. Comparison of GI, BOP and SUL on Hygiene Side (H) with Non-hygiene Side (NH) Over Time.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data Collection Intervals</th>
<th>Baseline</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>d</td>
<td>-8.64</td>
<td>30.38</td>
<td>32.79</td>
<td>30.69</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.084</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>BOP</td>
<td>d</td>
<td>1.59</td>
<td>12.64</td>
<td>13.92</td>
<td>32.59</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.743</td>
<td>.011</td>
<td>.006</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>SUL</td>
<td>d</td>
<td>-1.18</td>
<td>10.46</td>
<td>9.72</td>
<td>27.62</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.785</td>
<td>.026</td>
<td>.053</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

N = 39  p = .05

d = Wilcoxon signed rank test statistic values, difference in mean scores
p = calculated as 2-tailed test
**Bolded values** indicate significance
Data were analyzed to evaluate the correlation between SUL, GI, and BOP between sides. A Pearson correlation test revealed a moderate correlation on the NH side ($r = .66$, $p < .0001$ and $r = .61$, $p < .0001$) and a low correlation on the H side ($r = .49$, $p < .0001$ and $r = .45$, $p < .0001$) (Table III). Results suggest that with progression of gingivitis, there is an increase in the strength of the positive correlation between SUL, BOP, and GI.

**Table III. Correlation Between Sulfide Levels and Gingival Index, and Sulfide Levels and Bleeding on Probing for Hygiene (H) and Non-Hygiene Side (NH)**

<table>
<thead>
<tr>
<th>Sulfide Levels</th>
<th>Pearson Correlation Coefficient $r$</th>
<th>Gingival Index</th>
<th>Bleeding on Probing</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>$r = .66$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>$r = .49$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH</td>
<td>$r = .61$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>$r = .45$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p &lt; .0001^*$</td>
<td>$p &lt; .0001^*$</td>
<td></td>
<td>$p &lt; .0001^*$</td>
</tr>
</tbody>
</table>

N=39, *Indicates significance $p = .05$

**Discussion**

Analysis revealed a statistically significant positive correlation between SUL and GI and BOP on both H and NH sides; however, the strength of the association was higher for the NH side. These results suggest that H:S in gingival crevicular fluid (GCF) increases with the severity of gingival inflammation. This finding supports the work of Solis-Graffar et al, who found a positive correlation between the GCF volume and H:S production.\(^{17}\)

In the present study, the increase of GI scores on the NH side at days 7, 14, and 21 represents a direct gingival response to the continued plaque accumulations on the teeth. In addition, the significant increase of SUL on the NH side may be due to the proliferation of gram-negative bacteria in plaque.\(^{27}\) Since sulfide is a metabolic by-product of proteolytic gram-negative bacteria, increasing gram-negative bacteria would thereby increase sulphur by-products.\(^4\) Whether sulfur by-product is a direct contributor to the disease process, or merely a correlate, needs further investigation.

GI scores on the H side did not change significantly until day 21. During this study, participants reported that they focused on their oral hygiene status and may have increased brushing and flossing time on the H side in order to compensate for plaque growth on NH side. Considering a split-mouth design was used, microbes may have been transferred from one side to another. In addition, participants cognizant of the ever-growing plaque accumulations on the NH side reported using their tongues to feel the difference between the two sides, which may have facilitated the transfer of bacteria. Although data seems to suggest a significant positive correlation between SUL, GI, and BOP scores on both sides, the strength of the correlation was stronger for the NH side.

Current findings complement the work of researchers who first suggested the use of BOP, instead of visible inflammation, as an objective indicator of early gingival pathology.\(^{28}\) Data also supports the assumption that the GI is a reliable clinical parameter for early plaque-induced gingivitis, although transferring bacteria from one side to another may have affected GI scores. In contrast, present findings failed to support the work of researchers that suggested that GI is remarkably insensitive as a quantitative tool of early pathogenesis.\(^{11}\)

Data revealed a statistically significant difference in SUL over time between the H and NH sides on days 7 and day 21; however, SUL concentrations at day 14 did not differ significantly. This data supports the work of Zhou, who found a statistically significant difference in SUL levels at days 5-6, 8, 12-14, 15-16, and 19, but not at days 10-12.\(^{29}\) Both the work of Zhou and the present study demonstrated that SUL levels continued to rise throughout the experimental period and peaked at the end of the study despite the fact that at the end of week two, SUL concentrations were not significantly different between sides. Several theories may be advanced for this phenomenon. One explanation is that there is a decline...
in anaerobic activity at approximately 10-14 days of the inflammation process whereby bacteria deplete their nutrients in the pocket. Another explanation may be related to host resistance. Perhaps around days 10-14, the strength of the host begins to exceed the capability of the bacteria.

Visual signs of inflammation are susceptible to subjective interpretation, can be masked by medications and smoking, and may not reflect the true periodontal status in areas inaccessible to visual inspection. Therefore, monitoring SUL levels in addition to BOP and GI may more accurately reflect real-time disease activity within the sulcus. This interpretation needs to be validated by studying SUL levels in persons who use tobacco or take medications that may mask the clinical signs of inflammation. Identifying sites containing sulfides, in the absence of bleeding or visual gingival inflammation, may represent new and valuable diagnostic information.

It should be noted that data from this study suggest that SUL appear clinically at approximately the same time as BOP, but later than visible gingival inflammation. By day 21, SUL almost tripled from baseline, suggesting that SUL increase with the progression of gingival inflammation. Additional studies are needed to support claims of SUL as a valid indicator of early plaque-induced gingival disease and to determine how sulfide levels in the gingival sulci relate to ongoing gingivitis. The addition of microbial sampling with the evaluation of metabolic by-products of pathogenic bacteria may be one approach to diagnosing an active disease site.

**Conclusion**

Periodontal disease includes a group of inflammatory conditions of the periodontal tissue broadly categorized as gingivitis and periodontitis. Traditional clinical evaluations of the periodontium consist of an assessment of gingival inflammation, probing depth, loss of clinical attachment, bleeding on probing, and radiographic interpretation of the periodontium, which represent a retrospective analysis. Therefore, more reliable real-time clinical parameters are necessary to predict early disease activity prior to visual changes. The ideal assessment tool should be valid, reliable, time efficient, and easily used by clinicians.

The purpose of this study was to evaluate the relationship between VSC and gingival health status, and to identify the capability of VSC in detecting early plaque-induced gingivitis in the absence of clinical signs. Given the findings, the following conclusions are offered:

The Diamond Probe/Perio 2000 System is able to detect sites with elevated sulfide levels.

Sulfide monitoring may be a useful real-time adjunctive indicator of early plaque-induced gingivitis.

Considering the overall design and outcome of this study, the following recommendations are made:

Increase the number and variety of participants to broaden the study population.

Include microbial sampling to monitor the presence of gram-negative anaerobic bacteria that may correlate with sulfides.

Correlate sites without bleeding and inflammation and positive sulfides.

Despite limitations of this study, the knowledge of sites with elevated sulfide levels will provide immediate feedback so that treatment options for targeting destructive bacteria may be considered. The continued investigation of the short and long-term relationship between sulfides and periodontal disease may enable the profession to develop a new clinical technique for assessing active tissue breakdown. Such a technique would allow practitioners to intervene before visible tissue destruction has occurred; therefore, the monitoring of sulcular VSC holds promise as a new periodontal assessment technique.
Acknowledgements

This investigation was supported in part by the American Dental Hygienists' Association Institute for Oral Health, and the Diamond General Development Corporation, Ann Arbor, MI. The authors wish to thank Debbie Z. Williams for research assistance.

Notes

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References

The Comparative Effects of 0.12% Chlorhexidine and Herbal Oral Rinse on Dental Plaque-Induced Gingivitis

Elizabeth N Southern, Gayle B McCombs, S Lynn Tolle and Ken Marinak

Purpose. The purpose of this study was to determine the effects of two oral rinses—one 0.12% chlorhexidine rinse (CHX) and one herbal rinse (HBR)—on gingival health status over time.

Methods. Sixty-three participants were randomly assigned to one of three treatment groups: CHX, HBR, or placebo. For three months, participants rinsed twice daily (morning and evening) with ½ ounce of allocated rinse after brushing and flossing. Individuals were given the same type of soft bristle toothbrush and whitening toothpaste. No attempt was made to modify participants' routine oral care, except they were advised to refrain from use of any other oral rinse for the duration of the study. Data were collected at baseline (B), month one (1), two (2), and three (3) utilizing the Gingival Index (GI), Plaque Index (PI), and bleeding on probing (BOP). A full mouth periodontal probing was performed at baseline and at the completion of the study. A soft tissue oral assessment was completed at each visit. CHX, HBR, and placebo data were compared between three time intervals, B-1, B-2, and B-3. Statistical analysis was conducted by means of multiple regression using generalized linear models. Paired comparison tests - ANOVA followed by a post hoc Tukey test - were used to confirm results.

Results. CHX was the only oral rinse to demonstrate a statistically significant effect on the reduction of mean GI, BOP, and PI scores when compared to placebo. CHX demonstrated a 31% reduction in the proportion of GI scores between B-2 and a 29% reduction between B-3 (p=.003 and p=.012, respectively). CHX demonstrated a 19% reduction of BOP sites between B-1, 32% reduction between B-2, and 29% reduction between B-3 (p=.028, p=.000, and p=.005, respectively). CHX demonstrated a 20% reduction in PI scores between B-1, and a 28% reduction between B-2 (p=.005 and p=.032, respectively). The effects of HBR on reducing mean GI, BOP, and PI scores were not statistically greater than placebo at any time during the study.

Keywords: Dental plaque, gingivitis, chlorhexidine, oral rinse, herbal, mouthrinse

Introduction

Bacterial plaque is the primary etiological cause of chronic gingivitis. Many patients, due to difficulty maintaining thorough oral hygiene, accumulate significant amounts of bacterial plaque containing virulent pathogens. Effective oral care is important for all individuals; it is especially important for those who are compromised due to poor dexterity, an immune system deficiency, and/or are undergoing chemotherapeutic or radiation therapy. Despite one's best efforts, mechanical aids may fail to adequately remove plaque biofilm or "reduce the bacteria below the patient's threshold for disease." For these individuals, a therapeutic mouthrinse is often recommended as an adjunct to mechanical plaque control to help maintain gingival health.
A variety of oral rinses are available to consumers either by prescription (Rx) or over-the-counter (OTC). The increasing popularity of herbal or "natural" products has led companies to include these in their oral care product lines. Since herbal products may be purchased OTC, they have attracted millions of consumers who are looking for an alternative mouthrinse; however, more research is needed to determine the effectiveness and safety of these products.

To date, little research has been conducted on the comparative effects of 0.12% chlorhexidine versus herbal mouthrinses on plaque-induced gingivitis and plaque biofilm accumulations. The body of evidence pertaining to herbal products is small; therefore, tests should be conducted to gain evidence regarding their effectiveness and safety and to substantiate product claims. Fischman concluded that mouthrinse sales are closely related to whether a consumer likes the taste, smell, or color, and whether the consumer feels like the product leaves their mouth feeling fresh and clean. Depending on the effectiveness of the ingredients and patient compliance, evidence suggests that mouthrinses may act as beneficial adjunctive aids, especially for those who do not achieve optimal plaque control.

Review of the Literature

Current research indicates that plaque biofilm, a complex three-dimensional arrangement of bacteria in a self-sustaining community, has been associated with the initiation and progression of gingivitis and the onset of periodontitis. Van Dyke defined gingivitis as the "marginal inflammation of the gingiva comprising an inflammatory cell infiltrate, reversible destruction of collagen, and the clinical appearance of redness and swelling." Plaque-induced gingivitis begins at the gingival margin, and the virulent pathogens can progress throughout the gingival unit. Irreversible damage may occur when microbes migrate deeper into the epithelium. Antimicrobial agents may aid in disrupting pathogenic bacteria associated with plaque, thus aiding in the control of gingivitis. Healthy oral flora is influenced by effective plaque control; however, the pathogenic degree of the bacteria in plaque also plays a significant role, as does the host response, immune status, and amount of time that plaque remains on the tooth. Local and systemic factors should also be considered when addressing the host response in reducing the virulence of plaque biofilm since this interaction has the potential to exacerbate the gingival disease process.

Kornman states that there are three ways to treat or prevent gingivitis: 1) elimination of all clinically detectable plaque; 2) reduction of plaque below the individual's threshold for disease; and/or 3) alteration of the microbial succession in supragingival plaque. However, the depth that a mouthrinse effectively penetrates into a periodontal pocket of 1-6 mm is approximately 21% of the total pocket depth; therefore, the adjunctive use of a therapeutic oral rinse will best aid in altering the bacteria in subgingival plaque in individuals with gingivitis rather than periodontitis.

The present study focused on two specific mouthrinses: OTC herbal rinse (HBR) and 0.12% chlorhexidine rinse (CHX), both claiming to be effective in the treatment of gingivitis. Chlorhexidine (0.12%) has the American Dental Association (ADA) Seal of Acceptance and is Food and Drug Administration (FDA) approved for the reduction of plaque and gingivitis. Chlorhexidine also has long-standing research to substantiate its safety 13-16 and efficacy whereas the HBR mouthrinse used in this study is a newer, less researched product. Many studies have been conducted on 0.12% chlorhexidine mouthrinses; however, little research has been conducted to determine the efficacy of herbal mouthrinses and their ability to control plaque-induced gingivitis. Despite commonly known side effects such as temporary loss of taste; staining of the teeth, restorations, and mucosa; dry, sore mucosa; bitter taste; and a slight increase in supragingival calculus formation, CHX is considered the "gold standard" of antimicrobial rinses because of broad-spectrum antibacterial activity and substantivity of 8-12 hours. Chlorhexidine contains 11.6% alcohol, whereas the HBR tested in this study is a non-alcoholic, sugar-free product. In certain individuals whose oral health is compromised, or are recovering alcoholics, the addition of an effective therapeutic herbal oral rinse may be a valuable adjunct to brushing and flossing. Cost and accessibility are additional factors to be considered when selecting the appropriate oral rinse. The HBR and CHX mouthrinses used in this study were similar in price and quantity.
although the CHX product can only be obtained by prescription. Presently, the HBR oral rinse sells at a major pharmacy chain for $6.79 (8 oz) and the CHX product retails for approximately $15.00 (16 oz).

The manufacturer of the HBR product evaluated in this study claims it does not contribute to staining, tartar buildup, or taste alteration; possesses the ability to kill germs as effectively as the leading CHX prescription mouthrinse; and reduces gingivitis. The ingredients in the HBR include filtered spring water, vegetable glycerin, echinacea, goldenseal, calendula, aloe, bloodroot, grapefruit seed extract, citric acid, spearmint oil, peppermint oil, and cinnamon. Therapeutic benefits from these ingredients have not been extensively tested in a clinical setting. However, research conducted by Kaim et al suggests that HBR has an antimicrobial effect against A. viscosus and S. mutans in vitro. Additional research conducted by Scherer et al demonstrated HBR reduced gingival bleeding after three months of use as compared to placebo.

Methods and Materials

The protocol was reviewed and approved by the Old Dominion University Institutional Review Board. Qualifying participants signed informed consent, in duplicate, with one copy given to the participant and the other retained. Sixty-three individualss were recruited via flyers and campus emails. Individuals who met the following inclusion criteria were enrolled: GI score of 2 or 3, 18 years of age or older, and in general good health. Potential participants were excluded if they presented with advanced periodontal disease (AAP IV or greater), history of antibiotic use in the last 90 days, need for antibiotic pre-medication, or anterior facial restorations; used a daily anti-gingivitis rinse within the last 3 months; were pregnant, a smoker, or not in good general health. Participants were randomized to one of three product groups (CHX, HBR, or placebo). Individuals were identified by code numbers throughout the study.

At each appointment, the health history was reviewed and a soft tissue oral examination was performed. At the conclusion of the study, participants were evaluated for the need of a dental prophylaxis. This service was provided to participants who exhibited staining or calculus deposits attributed to the use of the study product.

A randomized design was utilized over a three-month period to evaluate the effects of 0.12% CHX, HBR, and placebo mouthrinses on gingival health and plaque accumulation. Information from product literature and previous studies suggest that the time period for initial treatment of a patient undergoing 0.12% CHX mouthrinse therapy should be limited to three months; then, the individuals’ gingival health status should be reevaluated. Numerous gingivitis studies have been conducted using an experimental period of three months or less; therefore, a three month study design was used for this study.

Data collection:

Baseline: Oral Exam (OE), Plaque Index (PI), Gingival Index (GI), Bleeding On Probing (BOP), and Probing Pocket Depth (PPD)

Month 1: OE, PI, GI, and BOP

Month 2: OE, PI, GI, and BOP

Month 3: OE, PI, GI, BOP, and PPD

In an attempt to replicate “real life” comparison group,s where a majority of consumers who purchase mouthrinse products have no recent history of a dental prophylaxis, no prophylaxis was conducted prior to study initiation. At baseline, participants were randomly assigned to one of three treatment groups: Group I (placebo), Group II (HBR), and Group III (0.12% CHX). All individuals were given the same type of soft toothbrush (Crest Complete, Procter and Gamble Co. Inc., Cincinnati, OH) and fluoride whitening toothpaste (Crest Dual Action Whitening Cool Mint, Procter and Gamble, Co., Inc. Cincinnati, OH) to decrease the possible side effects of staining and lessen examiner bias. Participants were instructed to use the assigned mouthrinse in conjunction to their normal oral hygiene routine. Product identifiers were removed from all containers. No attempt was made to modify participants' regular daily oral hygiene routine except they were advised not to use any other oral rinse for the duration of the study. Standardized written and oral rinsing instructions were provided.
at baseline and reviewed at each visit. Participants received periodic telephone calls to encourage protocol compliance and retention.

Data were collected using three periodontal assessment tools to assess gingival inflammation (GI), plaque accumulations (PI), and bleeding (BOP). A full mouth periodontal probing was performed at six sites per tooth (mesiofacial, facial, distofacial, mesiolingual, lingual, and distolingual) at baseline and at the end of the study using UNC-12 periodontal probes (Hu-Friedy Manufacturing Co., Inc., Chicago, Il). GI, BOP, and PI scores were obtained from the same six sites. The examiner and participants were blinded to product allocation. A single calibrated dental hygienist was used to collect all data. A research assistant was responsible for product allocation and supervising rinsing procedures. New products were dispensed at each appointment in unmarked bags and unused product was collected.

The Plaque Index (PI) was used to measure plaque accumulation. A score of 0-3 was assigned to six sites per tooth using the following criteria:

0 = No plaque on gingival margin.
1 = A film of plaque is supragingival, and adheres to the free gingival.
2 = Moderate plaque is present supragingivally and subgingivally.
3 = Heavy plaque is present supragingivally and subgingivally.

The Gingival Index (GI) was used to determine severity and location of gingivitis. A score from 0-3 was assigned to six sites per tooth, using the following criteria:

0 = Normal gingiva. Pale pink color, normal stippling, gingiva firm when probed. Gingival margin located on enamel or apical to CEJ.
1 = Mild inflammation. Slight changes in color of gingiva- more reddish than normal, slight edema. No bleeding on probing.
2 = Moderate inflammation. Gingiva is red to reddish-blue with moderate edema present and glazing. Bleeding on probing is present.
3 = Severe inflammation. Marked redness, edema, and ulceration. Tendency towards spontaneous bleeding.

Greenstein stated that bleeding on probing is an objective way to assess for clinical, bacteriologic, and histopathologic changes, since bleeding indicates areas infiltrated by inflammatory cells and histopathologic alterations due to the epithelial proliferation that occurs in early to established gingival lesions. Therefore, in the present study, BOP was independently scored as positive when bleeding was detected after 15 seconds, when stimulated by a periodontal probe.

**Statistical Analysis**

Statistical analysis was conducted by means of multiple regression using generalized linear models to analyze the paired difference between baseline and month one (B-1), month two (B-2), and month three (B-3). CHX and HBR were compared to placebo. Paired comparison tests, ANOVA followed by a post hoc Tukey test, were used to confirm the results. Data sets included continuous proportional data and ordinal data. Comparing the paired difference in proportion allowed participants to act as their own control. Change in proportion was calculated by subtracting the baseline proportion of unhealthy observations from the proportion of unhealthy observations following allotted months of rinsing. A negative value indicates that the proportion of scores decreased. Predictors of demographic data were analyzed separately. Pre-statistical analysis determined that age and race had an influence on GI scores; therefore, these factors were controlled for in the final data analysis. Age and race exhibited no statistically significant influence on PI or BOP. The p level was set at <0.05, a 95% confidence level, to minimize Type I error.
Results and Discussion

Sixty-three participants, 57% male (n=35) and 43% female (n=28) with a mean age of 25 years (sd=7.67), of whom 61% were Caucasian, 27% Asian, and 12% African American, were enrolled. During the course of the study, one subject withdrew from each group due to personal reasons, resulting in a final sample size of 60 (30 in each group).

Gingival Health (GI)

Randomization produced similar equivalent baseline groups that exhibited overall GI scores of 2 or 3. Analysis of GI scores indicate that CHX exhibited a statistically significant reduction when compared to placebo in the proportion of mean GI scores at B-2 and B-3 (p=.003 and .012, respectively) (Table I). These data support the work of Grossman who found a 29% reduction of gingival bleeding following three-month use of CHX.\(^7\) HBR did not reveal a statistically significant reduction greater than placebo in the proportion of GI scores at any time during the study. This is a conflicting comparison to the results by Scherer et al that indicated a 26.9% reduction in gingivitis following rinsing with HBR for three months.\(^8\)

<table>
<thead>
<tr>
<th>Table I. Change in Proportion of GI Scores of 2 or 3 as Compared to Placebo Over Time</th>
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</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
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<tr>
<td>----------------</td>
</tr>
<tr>
<td>HBR</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td>CHX</td>
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<td>Placebo</td>
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</tbody>
</table>

* Bold indicates a statistically significant reduction, p=.05

The greatest significant decrease in the proportion of GI scores, occurred in the CHX group from B-2 as indicated by a 31% reduction. One explanation for this comparison may be examiner bias; on the other hand, participants may have been enthusiastic about the study, resulting in greater compliance to rinsing regimens, which decreased as the study progressed.

Bleeding (BOP)

CHX exhibited a statistically significant reduction in BOP greater than placebo throughout the study as indicated by the decrease in proportion of positive bleeding sites between B-1, B-2, and B-3 (p=.028, .001, and .005, respectively) (Table II). HBR did not have a statistically significant effect greater than placebo on decreasing positive bleeding sites at any point in the study. CHX showed a comparable 29% reduction of both BOP and GI scores at B-3, which is expected since bleeding and gingival inflammation are reflected in GI scores. Ultimately, CHX was the only mouthrinse that demonstrated a statistically significant effect on the reduction of bleeding when compared to placebo.
In the present study, BOP data suggest that CHX had significant clinical effects on the improvement of gingival health. Over time, CHX effectively reduced clinical evidence of gingivitis as indicated by a statistically significant reduction in GI and BOP scores. The greatest decrease in BOP was evident from B-2 in the CHX group as indicated by a 32% decrease in positive bleeding sites.

### Table II. Change in Proportion of Positive BOP Scores as Compared to Placebo Over Time

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Treatment</th>
<th>B-1</th>
<th>B-2</th>
<th>B-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBR</td>
<td>Mean</td>
<td>-0.160</td>
<td>-0.236</td>
<td>-0.171</td>
</tr>
<tr>
<td></td>
<td>sd</td>
<td>0.090</td>
<td>0.149</td>
<td>0.116</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.100</td>
<td>0.059</td>
<td>0.955</td>
</tr>
<tr>
<td></td>
<td>se</td>
<td>0.044</td>
<td>0.046</td>
<td>0.041</td>
</tr>
<tr>
<td>CHX</td>
<td>Mean</td>
<td>*-0.185</td>
<td>*-0.315</td>
<td>*-0.291</td>
</tr>
<tr>
<td></td>
<td>sd</td>
<td>*0.172</td>
<td>*0.146</td>
<td>*0.144</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>*0.028</td>
<td>*0.000</td>
<td>*0.005</td>
</tr>
<tr>
<td></td>
<td>se</td>
<td>0.043</td>
<td>0.045</td>
<td>0.040</td>
</tr>
<tr>
<td>Placebo</td>
<td>Mean</td>
<td>-0.087</td>
<td>-0.147</td>
<td>-0.173</td>
</tr>
<tr>
<td></td>
<td>sd</td>
<td>0.144</td>
<td>0.138</td>
<td>0.124</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.006</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>se</td>
<td>0.031</td>
<td>0.032</td>
<td>0.029</td>
</tr>
</tbody>
</table>

* Bold indicates a statistically significant reduction, p=.05

In the present study, BOP data suggest that CHX had significant clinical effects on the improvement of gingival health. Over time, CHX effectively reduced clinical evidence of gingivitis as indicated by a statistically significant reduction in GI and BOP scores. The greatest decrease in BOP was evident from B-2 in the CHX group as indicated by a 32% decrease in positive bleeding sites.

**Plaque (PI)**

Only CHX had a statistically significant effect greater than placebo on reducing the proportion of PI scores of 2 or 3 (Table III). CHX demonstrated a 20% reduction in PI scores between B-1, and a 28% reduction between B-2 (p=.005 and .032, respectively). Although the CHX group demonstrated a 28% decrease in PI scores from B-3 (p= 0.098), this reduction was not significantly different from placebo. HBR did not have a statistically significant effect greater than placebo on decreasing the proportion of PI scores at any time during the study.
In the majority of cases, participants were examined at the same time of day to reduce extraneous variables in plaque accumulation, such as the length of time between home care and data collection. Variations in plaque accumulations may have been influenced by the Hawthorne effect or the tendency of participants to improve behavior because of the expectations created by the situation. On the other hand, as the study progressed, participants may have become more lax with their oral care resulting in an increase of PI scores.

Probing Pocket Depth (PPD)

Full mouth periodontal probing measurements were obtained at baseline and month three (B-3). Statistical analysis showed no statistically significant change in PPD in any of the groups.

Summary and Conclusions

The purpose of this study was to determine the comparative effects of 0.12% CHX and HBR to placebo on gingival health and plaque biofilm accumulations over time. The ability of an oral rinse to be retained in the oral cavity and maintain potency over an extended length of time has been debated. Lang stated that the substantivity of an antimicrobial agent needs sufficient contact time with a microorganism in order to inhibit or kill it. Chlorhexidine, with a substantivity of 8-12 hours, is considered to be highly effective; whereas, the substantivity of the HBR is unknown. Conclusions from the present study suggest that CHX was effective in killing virulent bacteria found in plaque biofilm, and is evident by a statistically significant reduction in the proportion of GI scores and BOP sites in the CHX group. The greatest significant decrease in the proportion of GI scores occurred in the CHX group between B-2 as indicated by a 31% reduction. There is not enough statistically significant evidence to suggest that HBR had a greater effect in reducing GI scores than placebo. During the study, extraneous variables such as length of study and busy schedules may have reduced participants' enthusiasm, resulting in less compliance to rinsing regimens, or perhaps participants who enrolled with minimal gingivitis may have exhibited healthier gingival status over less time.

| Table III. Change in Proportion of PI Scores of 2 or 3 as Compared to Placebo Over Time |
|---------------------------------|-----------|-----------|-----------|
| Treatment     | B-1  | B-2  | B-3  |
| HBR           | Mean | -0.107| -0.197| -0.209 |
|               | Sd   | 0.107 | 0.142 | 0.156 |
|               | P value | 0.250  | 0.306 | 0.505 |
|               | Se   | 0.053 | 0.069 | 0.071 |
| CHX           | Mean | *-0.196* | *-0.0275* | -0.280 |
|               | Sd   | *0.251* | *0.286* | 0.293 |
|               | P value | *0.005* | *0.032* | 0.098 |
|               | Se   | 0.052 | 0.068 | 0.070 |
| Placebo       | Mean | -0.046| -0.126| -0.161 |
|               | Sd   | 0.098 | 0.190 | 0.202 |
|               | P value | 0.216  | 0.012 | 0.002 |
|               | Se   | 0.037 | 0.048 | 0.050 |

* Bold indicates a statistically significant reduction, p=.05
Results indicate that CHX had a statistically significant effect on decreasing the paired difference in the proportion of BOP sites compared to placebo, as indicated by the decrease in positive BOP scores between B-1, B-2, and B-3. The greatest significant decrease in BOP sites was evident in the CHX group between B-2 as indicated by 31% reduction. There is not enough statistically significant evidence to suggest that HBR is more effective than placebo in its ability to reduce BOP over time.

The results of this study indicate that only CHX had a significant effect on decreasing moderate to heavy plaque at B-1 and B-2 when compared to placebo. Although the greatest reduction in PI scores occurred between B-3 for CHX, the results were not statistically different than placebo. The largest significant decrease in plaque scores occurred in the CHX group between B-2 as indicated by a 28% decrease in the proportion of PI scores. A 16% reduction of PI scores between B-3 in the placebo group may be due to the Hawthorne effect as participants reached the end of the study. There was no statistically significant decrease in PI scores in the HBR group when compared to placebo at any time during the study.

Little research has been conducted on the comparative effects of herbal oral rinses and chlorhexidine oral rinses. With the proliferation of herbal oral care products, it is important for clinicians to make evidence-based decisions when making product recommendations. Research by Kaim et al suggests that there are certain ingredients in herbal oral rinses that exhibit evidence of anti-inflammatory and anti-fungal therapeutic effects. These components include echinacea, goldenseal, and grapefruit seed extract. However, research needs to be conducted to determine the substantivity of HBR, as well as determine its antimicrobial effects on gingivitis, plaque biofilm accumulation, and related bacteria.

Based on the results of this study, it is important to note that 0.12% CHX mouthrinse effectively reduced the clinical symptoms of plaque-induced gingivitis, and had a statistically significant effect on the reduction of plaque scores. Data from this study suggests that CHX is more effective than HBR in reducing clinical indicators of gingivitis when compared to placebo. Data does not support HBR product claims suggesting that it is as effective as CHX. Therefore, individuals who are looking for a “natural,” sugar-free, non-alcohol mouthrinse should be advised that there is little research to support the effectiveness of herbal oral rinses. Dental professionals will benefit from this body of evidence as they seek to make evidence-based product recommendations.

Suggestions for future studies include: (1) address the substantivity of HBR mouthrinses; (2) incorporate microbial analysis in order to draw conclusions about antibacterial effects; (3) expand study population to include broader disease status and varied age groups; (4) extend study to six months; (5) add stain and calculus indices, (6) increase internal validity by supervising rinsing; and (7) determine if the whitening toothpaste interacted with components of the mouthrinse.

Acknowledgements

Researchers are grateful to Russell Bogacki, DDS, MS, assistant professor at Virginia Commonwealth University School of Dentistry for statistical support and Deborah Z. Williams for research assistance.

Notes

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References

Faith-Based Initiatives and Service-Learning: A Match Made in Heaven

Sherri M Lukes and Faith Y Miller

Southern Illinois University, Carbondale

Service-learning opportunities can provide students with excellent multicultural, applied experiences, while providing much-needed services to underserved populations. In an age of shrinking budgets, partnering faith-based organizations and educational institutions creates an avenue for positively impacting access to care for these populations. A dental hygiene faculty member and six dental hygiene students incorporated preventive dental services into a construction mission trip to Tamaulipas, Mexico. Dental services included periodontal debridement, routine prophylaxes, dental sealants, and fluoride varnish applications. Services were provided with portable dental equipment for both adults and children in a church in Palmillos, and under a canopy in the village of La Mula. Informed consent for treatment was obtained. Twenty-three adults and 38 children were served in the two villages. The dental hygiene students received internship hours for a rural health and geriatrics course, as part of a baccalaureate-degree dental hygiene curriculum. Further, students participated in a sealant grant program and mouthguard project. Area church leaders offered a facility in which to provide services from both programs to children within the predominately African American community near the university. Consent forms were obtained from churches, allowing children to receive services during a church-sponsored summer lunch program and vacation Bible school. Dentists, dental hygiene and dental technology faculty, and dental hygiene students participated in both the sealant and mouthguard programs. A total of 45 children received care; all received exams, and 80 sealants were placed. Thirteen children received sport mouthguards and three received bruxism appliances. Reflective writing about all of the service-learning experiences is used for program evaluation. All students deemed these service-learning experiences as a very beneficial component of their educational experience.
Project to Research Alternatives for Dental Health Education Programs

Heidi Philley

Mohawk Valley Dental Hygiene Association; Oneida-Madison County Dental Coalition

The program purpose was to expand access to dental health education in central New York, where there is a need to find alternative ways to raise oral health awareness among children and their families. The Oneida-Madison County Dental Coalition fulfills the objectives of a preventive dentistry grant for high-risk children. One objective is to educate children and families about the importance of good oral health habits. The coalition partnered with the Mohawk Valley Dental Hygienists' Association (MVDHA) and with the Mid-York Library System to develop "Dental Health Story Boxes." Each story box includes books about teeth and dental visits, a puppet and toothbrush, and a resource book with activity sheets. The library system sends out periodic broadcasts with information about the Dental Health Story Boxes to its 44 public libraries. The libraries request the boxes for interested individuals. Anyone can feel confident of a successful program using the outline and contents of the Dental Health Story Box. Evaluation is done by the individuals at the 44 libraries using this educational tool, and they are reviewed regularly. The evaluation form asks for numbers of users and their ages, and comments on books, resource materials, and puppets. There has been positive response from those using the story boxes (an evaluation sheet is included) each time the boxes go out. This year they have gone out over 120 times. Dental hygienists have favorably reviewed the Dental Health Story Box at the local and state level. Many have requested information on how to duplicate it in their areas. There is dental health education sustainability in having a Dental Health Story Box available for the public library. MVDHA has oversight on the project and plans to continue and evaluate the project on a yearly basis.
A Collaborative Education Program in Dental Assisting, Dental Hygiene, and Postgraduate General Dentistry

Constance Gore, Donna Solovan-Gleason, Krista Schobert, Thomas Porter and Shannon Johnson

Traditionally, the education of dental assistants, dental hygienists, and general dentistry residents takes place in separate clinic areas and in separate curriculums with limited or no interaction among the disciplines. In contrast, dental assistants, dental hygienists, and dentists are expected to practice in a cohesive and efficient manner upon graduation. Recognizing this as a problem, a facility was designed and built to integrate the dental assisting and dental hygiene programs with the general dentistry residency program for didactic and clinical education. The students are educated in the team concept of providing patient care. The clinic facility is modeled on a private practice office with a common reception area; the dental hygiene treatment area is immediately adjacent to the dental resident operatories. Dental assisting students assist in the dental hygiene and resident operatories. Each dental hygiene student, dental assisting student, and dental resident is grouped into a treatment team. Patient treatment is planned and coordinated by the team with faculty supervision. Responsibilities of dental hygiene students include the patient's initial periodontal therapy, oral hygiene instruction, post-surgical management, and post-care maintenance. Dental assisting students provide chairside assisting for dental hygiene students and residents, schedule appointments, and monitor patients' progress through treatment. Dental residents are team leaders and are responsible for providing patient treatment and monitoring the dental hygiene and dental assisting students. Meetings provide the members and the supervising faculty the opportunity to review each patient's progress. All team members participate in case presentation seminars. This collaborative program is a work in progress to determine the educational value of having dental hygiene, dental assisting, and general dentistry residents train together in preparation for the team concept of providing care. Evaluation of the program will be done through conventional assessment processes to include review of national and clinical board exam scores to compare student scores to those of other dental hygiene and dental assisting schools, and the review of graduate student and employer surveys to determine if students are judged better prepared to enter the workforce.
Estimating the Cost Savings of a Targeted Sealant Program in Colorado

Joan O'Connell, Diane K Brunson and Theresa Anselmo

Dental sealants have been shown to be effective in preventing caries in permanent molars. Targeting schools for sealants based on free and reduced-cost lunch participation has been shown to be cost-effective. Estimating the cost, including personnel, portable units, and disposable supplies, to meet the Healthy People 2010 objective for sealants in Colorado was undertaken. This information would be used to provide state policy makers with information to set priorities for oral health prevention strategies. Utilizing data from the Colorado Chopper Topper school-based sealant program, which serves the five-county Metro Denver Area, the average program costs were determined. The Chopper Topper program is estimated to serve 32% of eligible schools and 1,500 children in the target area yearly. In 2002, the prevalence of dental sealants in first permanent molars among third graders in Colorado was determined using a convenience sample of 19 counties and estimating the prevalence of sealants statewide. Twenty-nine percent of third graders were found to have at least one sealant, significantly less than the desired Healthy People 2010 objective and Maternal Child Health National Oral Health performance measure. By analyzing these data, the overall dental utilization rates and restoration sequelae over a lifetime obtained from Delta Dental Plan of Colorado, and the societal costs of lost productivity, the cost savings of averted caries through the expansion of the Chopper Topper Sealant Program, by initiating similar programs throughout the state, was projected. The results indicate that the state could easily be divided into target regions served by teams of dental hygienists who would, in most cases, share portable dental units and serve second-grade children in all 276 eligible elementary schools. If all targeted schools agreed to participate and 85% of children received sealants, the percentage of Colorado third graders with at least one sealant would exceed the Healthy People 2010 objective of 50%.
Value of a National Board Dental Hygiene Review Course: A National Survey

Chris French Beatty, David D Marshall and Heather O Mapp

Funding for this project was provided by Dental Hygiene Seminars, Inc.

A variety of National Board Dental Hygiene (NBDH) review courses are available to dental hygiene students. These courses are highly publicized and costly. Dental hygiene educators are called on to recommend the appropriateness of review courses. The purpose of this study was to evaluate the value of a nationally based NBDH review course offered by Dental Hygiene Seminars, Inc., in various locations across the United States. After institutional review board approval by Texas Woman's University, a questionnaire was mailed to 1,648 individuals who had attended the course in 2002. The mailing labels were procured from the course directors. Questions on the questionnaire related to students’ year of graduation, type of dental hygiene program, grade-point average (GPA), English as a Second Language (ESL) status, number of attempts required to pass the NBDH, passing score on NBDH, the materials they used to study for the examination, factors that influenced their decision to attend this course, relevance of the course to the NBDH, value of the course, factors that made the course beneficial, and willingness to recommend the course. Of the 1,648 questionnaires mailed, 156 were returned as undeliverable. Of the remaining 1,492 questionnaires, 439 were returned for a 29% response rate without a follow-up mailing. All data were self-reported. The data will be analyzed with Statistical Package for Social Scientists software (Chicago, IL) to figure counts and percentages. Also, correlations and multiple regression will be run to analyze the relationship of performance on the NBDH and perceived value of the course with various factors, including year of graduation, type of program attended, GPA, ESL status, number of attempts required to pass the NBDH, and materials used to study for the examination.
Oral Health Care Practices and Perceptions Among Nursing Home Residents: A Case Study

Bridget M Boyce, Christina B DeBiase, Nancy L Adams and Mary W Carter

Purpose. Currently, little knowledge exists about the extent to which: 1) nursing home residents perceive their oral health care as being adequate, 2) nursing home residents’ perceptions and actual oral health status are congruent, and 3) oral health care outcomes and residents’ perceptions of their own oral health care are influenced by levels of physical functioning. The purpose of this study was to evaluate the oral health practices and perceptions of oral health care among cognitively intact nursing home residents.

Methods and Materials. Institutional review board approval was obtained, and a modified, one-shot case study design,* a 20-question resident interview, and a 10-category oral health care evaluation were utilized in three encounters with the accepting sample of 10 West Virginia nursing home residents. The interview identified each participant’s current and past oral health care practices, perceptions about their current oral practices, and levels of need and functioning in the nursing home. The evaluation assessed the current oral health status of the participants. A licensed West Virginia dentist was present during the evaluations.

Results. All participants (N = 10) completed the assessments. Data analyses, including percentages, frequencies, and measures of dispersion, were conducted using the JMP program, version 3.

Conclusions. Conclusions that may be drawn from this study include: 1) study participants who are dependent on the nursing home staff for oral health care needs are most likely to receive oral health care, 2) the quality of oral health care performed by the nursing home staff or resident is lower than the current oral health care standards and recommendations, and 3) study participants’ barriers for oral health care were commonly influenced by their physical functioning.

*A modified, one-shot case study is a descriptive analysis of a particular group of individuals within one setting that reflects moderation, apparent in this study by three discrete visits to the participating nursing home.
Herbal Alternative Medicine Use in an Urban Dental Hygiene Clinic

Marji J Harmer-Beem, Bernice Mills and David L Baker

Purpose. The purpose of this study was to identify common herbal medicines used and determine the prevalence of usage among adults attending an urban dental hygiene clinic. There has been a rapid increase in the nationwide use of non-regulated, readily available, herbal alternative medicines. Patients do consider these remedies therapeutic, but not in the same class as prescription medications. Some herbal medicines show an unfavorable risk-benefit profile, such as bleeding and immunosuppression. Previous studies have shown that patients do not consult their physician prior to or during herbal medicine consumption.

Materials and Methods. Exempt review was sought and obtained from the institutional review board at the University of New England. A records review was conducted for one academic year to determine usage and prevalence of herbal or alternative medicines. Selection criteria included a consecutive sample of all adults 18 years of age and older (N = 1,694) from an urban dental hygiene clinic. The sample was taken for two uninterrupted semesters.

Results. Descriptive statistics were used to analyze results for frequency. Of the patients interviewed for prescription, over-the-counter, and herbal or alternative medications, a subset (n = 134) of 8% reported use of herbal or alternative medicines. This compared to studies reporting national surveys at 9.6%. Results from literature reports range between 4.8% and 13.0%. Sixteen herbal alternative medicines were identified as commonly consumed by individuals included in this study. Echinacea, glucosamine, garlic, gingko, ginseng, and brewers yeast were identified as the top six used.

Conclusion. People do use herbal medications, some of which can have oral health implications. This study shows usage to be consistently prevalent when correlated with other studies. Dental hygienists should understand and inquire about usage of herbal medicines. Dental hygienists need to be vigilant when interviewing for herbal or alternative medication use for safe practice.
Cross-Cultural Adaptability of Dental Hygiene Students and Faculty

Cassandra B Holder-Ballard

University of Tennessee Health Science Center, Memphis

Purpose. Health care educational programs are being urged to produce culturally competent health care providers to meet the needs of an increasingly diverse U.S. population. The purpose of this study was to first compare the cross-cultural adaptability of first- and second-year dental hygiene students to their faculty; and, secondly, to evaluate the influence of five demographic variables (age, race, marital/family status, place of residence, and growing up in an ethnically diverse community) on cross-cultural adaptability.

Methods and Materials. The Cross-Cultural Adaptability Inventory (CCAI) measures emotional resilience, flexibility/openness, perceptual acuity, and personal autonomy. A demographic survey and the CCAI was administered to dental hygiene students (N=62) and their faculty (N=16) at a baccalaureate-degree program located in the southeast United States. One-way analysis of variance (ANOVA) was used to analyze the data using the Statistical Package for Social Sciences (SPSS, Chicago, IL). Both the CCAI composite score and the four individual research dimension scores were used as dependent variables.

Results. No statistically significant differences were found in the CCAI composite scores between dental hygiene students (juniors or seniors) and faculty. However, an analysis of the four research dimension scores found that the groups (junior dental hygiene students, senior dental hygiene students, and faculty) differed in two areas. For "flexibility and openness," junior students scored 64.94, seniors scored 65.93, and faculty scored 70.75. Faculty scored significantly higher than dental hygiene juniors in this area, P = .036. A significant difference was also found in the area of "personal autonomy" (juniors: 35.36, seniors: 32.76, and faculty: 34.06). Dental hygiene juniors scored significantly higher than senior dental hygiene students, P = .015. Analysis of the demographic factors found a significant difference in the CCAI composite scores of marital/family status (P < .002). Individuals partnered without children (M = 245) scored higher in this sample than those single without children (M = 231) and those partnered with children (M = 218).

Conclusion. In this sample, differences were found in the CCAI scores between students and faculty; and marital/family status appeared to be the most significant demographic factor.
Purpose. Currently, no standard abrasive scale exists for dental prophylaxis pastes. Manufacturers determine their definitions of abrasive grit levels. The purpose of this study was to measure resulting surface roughness on bovine enamel of a representative sample of prophylaxis pastes.

Materials and Methods. The study consisted of an eight-item, descriptive survey of prophylaxis paste manufacturers to gather information, a pilot study to determine testing variables, and an actual analysis of bovine tooth specimens. The sample comprised prophylaxis pastes, pumice, and toothpaste. Pumice was chosen as the standard for abrasive testing, and toothpaste was selected because it is recommended as an alternative when performing selective polishing. Equipment was constructed for applying a slurry of abrasives to mounted mandibular bovine incisor specimens at 2500 rpm for five seconds under a load of 145 g. Seven specimens were subjected to testing for each of the 17 prophylaxis pastes, toothpaste, and fine pumice, totaling 133 test specimens. Pretest and posttest surface roughness readings were recorded using a surface roughness tester equipped with a diamond tip stylus. Repeated measures ANOVA was used for statistical analysis to remove the variability from specimen to specimen, so that for each paste the pretest versus the posttest may be evaluated independent of specimens.

Results. Repeated measures ANOVA determined that changes in roughness were significantly different among all pastes (p<.0001). A surface roughness scale of current products was developed and results showed that few pastes actually "polished" and created a smoother surface. When comparing individual pastes to fine pumice, two pastes were found to have a significantly higher increase in surface roughness, ten showed no significant difference, and six showed a significant decrease in surface roughness.

Conclusions. These results indicated that very few products polished and created a smoother surface. Clinicians must evaluate individual patients' needs, consider selective polishing, and make evidence-based decisions when choosing a product.

Keywords: abrasives, selective , polishing, prophylaxis pastes, enamel surface roughness

Acknowledgements

Funding for this project was provided by the West Virginia University School of Dentistry Research Corporation.
Oral Health and Pregnancy: An Intervention Study

Barbara C Bush, Linlee Allen, Andi Lindsey and Sara Skelton

Western Kentucky University

Purpose. The research evidence is growing that there is a strong correlation between maternal oral health and adverse pregnancy outcomes. The purpose of this study was to evaluate the effect that an informational brochure about the relationship between oral health and pregnancy, given to pregnant women during prenatal visits, had on their attitudes toward seeking oral health care during pregnancy.

Methods and Materials. This pilot study employed a one-shot case study design to examine these variables. Descriptive statistics were used to provide an understanding of patient attitudes. A facility with 22 different caregivers was selected. Permission was granted to anonymously survey their patients (N=33). Upon checking in for their appointments, the women were handed the brochure and asked to read it and respond to the attached questionnaire. The questionnaire, which was not pretested, consisted of three closed-ended questions. Additionally, the caregivers were questioned regarding their attitudes and practices on the subject of oral health and prenatal care. The caregivers’ questionnaire also consisted of three closed-ended questions.

Results. Results of the survey indicate that 81.8% of the patient respondents plan to seek dental treatment during their pregnancy and that the brochure influenced this decision in 42.4% of those surveyed. One hundred percent of those surveyed (N=13) felt that good oral health care is important during pregnancy. Only 53.8% said they currently incorporate oral health care and its importance into the prenatal care of their pregnant patients. All caregivers surveyed (100%) indicated that they would give this information to their patients if it were made readily available.

Conclusions. Results of this study indicate that an informational brochure affects the decision to seek oral health care and that caregivers are receptive to providing this information to their patients if it is readily available. Considering the results of this study and the research evidence that supports the correlation between maternal oral health and adverse pregnancy outcomes, it seems prudent to provide prenatal caregivers with informational brochures that could be distributed to their patients.

Keywords: Pregnancy, maternal oral health care, prenatal care
Assessing Activity Level of Sigma Phi Alpha Chapters

Claudine Paula Drew

New Jersey Dental School

Purpose. Sigma Phi Alpha (SPA), the national dental hygiene honor society, strives to promote, recognize, and honor scholarship, leadership, and service among dental hygiene students and the dental hygiene community at large. The organizational structure includes the Supreme Chapter, with 190 component chapters located in dental hygiene programs in universities and community colleges. SPA sought to determine why some chapters have high activity levels of inducting new members, awarding continuing education credits for courses presented, and financially supporting local scholarship recipients for academic excellence, while other chapters seem to become weaker and non-functioning over time.

Methods and Materials. A questionnaire was developed to determine the current activity levels of SPA chapters, to assess the inactivity of formerly established chapters, and to collect data on why some dental hygiene programs have never petitioned for a chapter. Of the 286 questionnaires mailed to U.S. and Canadian schools, 121 were returned (43%).

Results. Approximately one third of the returned questionnaires (41%) indicated that their component chapters’ levels of activity were poor or non-existent. The main reasons given for inactivity were lack of leadership (44%) and no interest (16%), or a combination of the two (28%). The two reasons least given for inactivity were overwhelmed faculty (8%), and a combination of no leader, no meeting place, and no interest (4%).

Conclusions. It was concluded that chapter inactivity resulted mainly from lack of leadership and limited interest. The Supreme Chapter developed strategies for support and activity improvement. These strategies include 1) better identification of inactive chapters; 2) the pairing of a chapter with limited leadership to one with high activity that would lend support; and 3) mentoring or coaching of a potential chapter by either the SPA regional trustees or another local highly functioning chapter.

Keywords: Honor society, organization activity levels, leadership
A Three-Year Study on the Relationship of an Internal Board Review Course and Dental Hygiene Student Performance on the National Board Dental Hygiene Examination

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Purpose. The purpose of this study was to determine whether an internal mock board review course (MBC) could help students improve their National Board Dental Hygiene Examination (NBDHE) scores and study skills. This non-credit, pass or fail course was developed as a requirement for graduation.

Methods and Materials. The fall content was based primarily on material from Dr. Esther Wilkins' Clinical Practice of the Dental Hygienist 8th Edition, along with supplemental Internet information. Multiple mock board quizzes were given prior to the end of February, when students must be certified for the spring examination.

Results. Seventy-four students completed surveys at the beginning and end of the fall semester. When three years’ worth of MBC scores were compared to actual NBDHE scores, the MBC scores were within five percentage points of the actual NBDHE scores 61% of the time. At the beginning of the MBC, 31% of the students thought they would achieve a score of 90% or above on the NBDHE. At the end of the MBC, student surveys indicated that 5% believed they would achieve 90% or above. Seven percent of the class actually did achieve above 90%, proving that the course successfully showed students the depth of study necessary to score 90% or better. Seventy-nine percent of responding students appreciated the “jump start,” early study schedule, and review of background material.

Conclusions. The internal board review course motivated students to study earlier than they would have on their own, and our MBC was able to accurately predict which students were ready to take the NBDHE in the spring semester (70% of the class). Because it is critical to find new and innovative ways to motivate students, further study is ongoing to improve performance for students who did not take the spring NBDHE, and to examine variables that affect student success.
Infrared Technology: An Adjunctive Instructional Medium

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Purpose. The ability to effectively detect the position and location of subgingival dental calculus as part of scaling and debridement procedures is a primary process performed by dental hygienists and, as such, is vital to the periodontal health of dental clients. The purpose of this research is to examine the use of infrared technology (IrT) as an educational adjunct to learning the skill for subgingival calculus detection. It was hypothesized that the use of IrT as a method of augmented feedback would increase students’ motor skill acquisition for the detection and removal of subgingival calculus on patients.

Methods and Materials. The research was an experimental, treatment-control group, comparison design, using 30 senior dental hygiene students. The independent variable was the use of IrT for calculus detection, and the dependent variable was the increase in student motor skill acquisition for calculus detection. Methods for data collection included student-patient encounter forms post-scale, a rubric to evaluate performance for subgingival exploratory instrumentation, and a post-treatment student interview.

Results. The analysis of data revealed a non-statistically significant result in comparison of efficacy for calculus removal between groups, \( t_{20} = .313, P = .76, 1\)-tailed and a non-statistically significant result in comparison of exploratory skills, \( t_{28} = .611, P = .95, 1\)-tailed. On the post-treatment interview, 47% supported that motor skills were reinforced with the use of IrT, 67% supported that IrT validated student findings with a hand-held explorer, 60% supported that the IrT identified calculus not identified by student, and 60% felt that use of IrT improved motor skills. However, only 27% noted that the use of IrT actually accelerated motor skill development.

Conclusions. In conclusion, researchers failed to reject the null hypothesis. Qualitative evidence suggests that IrT can have an impact on student motor skill development; however, the research would have to eliminate factors that adversely impacted the usage of the IrT. In addition, it is recommended that researchers include an ethnographic inquiry into the motivations for usage of infrared technology.

Acknowledgements

Funding was provided by Marriott Research and Development Committee, Dr. Ezekiel R. Dumke College of Health Professions.
A Rural School-Based Oral Health Program

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The purpose of this program is to improve the oral health of school-aged children through the development of a model school-based oral health program integrated into two existing school-based health centers. Recognizing that dental decay is the most prevalent single disease affecting children, and that high-risk populations experience disproportionate amounts of disease, a school-based oral health program represents an ideal mechanism to provide care to children in need. The pilot program represents a model for development and implementation of a comprehensive school-based oral health program in two underserved communities in South Texas. The program is a collaborative effort of the Methodist Healthcare Ministries; the University of Texas Health Science Center at San Antonio Dental School, Department of Dental Hygiene; the Texas Department of Health; community dental clinics; and health professionals, teachers, parents, and administration of the respective schools.

The comprehensive oral health model focuses on the prevention, treatment, and education needs of 9,100 school-age children in two school districts. The prevention component includes annual assessments, sealants, fluoride treatments, mouth guard fabrication for sports, oral hygiene instruction, nutrition, tobacco cessation, and early intervention programs. The treatment component includes essential services such as emergency, diagnostic, preventive, and restorative care. Oral health education was incorporated into the program for children, parents, and teachers. Dental hygiene faculty and students are providing the preventive treatment and educational services to children at the school-based health centers.

This program addressed Healthy People 2010 objectives in the following areas:

1. Decrease the percentage of children needing urgent dental care. 1,602 children received treatment in the school clinic, which included urgent care needs. However, the annual assessment in year three showed a 3% increase in urgent care needs because of the increased number of new and emergency patients.

2. Decrease the number of children with untreated tooth decay. Annual assessment and screening of 1,208 children in kindergarten and the second, third, seventh, and eighth grades showed a 9% decrease from year one to year three.

3. Increase the percentage of children with annual dental visits. Annual parent survey of children in kindergarten and the third and eighth grades showed a 2% increase. However, 125 children were seen at the school clinic in year one and 948 children in year three.

4. Increase percentage of children receiving preventive dental services. In year one, 187 children received services and, in year three, 2,464 received services.

5. Improve oral health knowledge of children and school personnel. Pre- and posttests of students in kindergarten and the first, second, and third grades and school personnel indicated a 3% to 17% increase in knowledge.
Acknowledgements

The first three years of the model program were funded by a grant from the Robert Wood Johnson Foundation, and continuation funding is being provided by Methodist Healthcare Ministries.
A Comparison of the Academic Performance of Dental Hygiene Certificate and Baccalaureate Students

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In 2004, the School of Dental Hygiene at The University of Texas Health Science Center at Houston graduated the first class of dental hygiene students with baccalaureate degrees. The purpose of this study was to compare the academic performance of students in the certificate and the baccalaureate programs. The seventy-four participants were drawn from the students in a dental hygiene program at a dental school. The class of 2004 had ten BS and twenty-six certificate students. The class of 2005 had twenty-two BS and sixteen certificate students. The pre-requisite grade point averages and the cumulative grade point averages of students were compared using an analysis of covariance (ANCOVA) to determine differences. The ANCOVA yielded an F-ratio of 0.071 (Class of 2004 at the end of two years) that was not statistically significant (p =0.791). The results obtained from the ANCOVA yielded an F-ratio of 0.036 (Class of 2005 at the end of one year) that was not statistically significant (p = 0.850). The pre-requisite credit hours and the cumulative grade point averages were compared also using ANCOVA. The ANCOVA yielded an F-ratio of 0.482 (Class of 2004 at the end of two years) that was not statistically significant (p=0.493). The ANCOVA yielded an F- ratio of 0.102 (Class of 2005 at the end of the first year) that was not statistically significant (p=0.751). No differences between the academic performance of students in the certificate and the BS programs of the class of 2004 or 2005 were found. It could be concluded from this study that students in the certificate program and the BS program performed similarly. Since the BS program has only been available since 2002, further studies are planned. Permission to conduct this study was obtained from UTHSC Committee for the Protection of Human Subjects.
Achieving Autonomy in Dental Hygiene Practice through a School-Based Oral Health Program

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Purpose. Ensuring that all Americans have access to quality oral health care has become the primary focus of local, state, and federal government agencies; and the issue has also been placed on numerous legislative agendas. The purpose of the school-based project at the Southern Illinois University Carbondale (SIUC) Dental Hygiene Program (DHP) was to assist in meeting the goals outlined in the Oral Health in America: The Report of the Surgeon General, Healthy People 2010 (HP 2010), the Illinois Oral Health Plan (IOHP) and A National Call to Action to Promote Oral Health. Dental hygiene (DH) students play a significant role in meeting current access issues. Recent legislation in Illinois has allowed registered dental hygienists (RDHs) to practice under the general supervision of a dentist.

Significance. To close the gap in the disparities concerning access to care, DH students have been utilized in multiple settings beyond the traditional and institutionally-based dental hygiene clinic. DH students are being used to staff school-based dental sealant programs as well as safety-net clinics serving a more diverse population including those clients with special needs. Since the students are still matriculating through school, relaxation of the supervision laws have increased the opportunities for those needing the most care to be seen and subsequently treated in facilities or remote sites by DH students who are supervised by the RDH. To date, the Dental Sealant Grant Program (DSGP) at SIUC has seen well over 250 what is considered at-risk, low-income children, placed approximately 400 sealants and has established a referral system for children requiring urgent or routine care through the campus-based Community Dental Center (CDC) and the Illinois Children’s Health Foundation (ICHF), which is an extension of the CDC. Both clinics utilize DH students as primary clinicians, supervised by the DH program faculty. This approach to treatment, lends itself to meeting the oral health needs of the population through effective collaborations and partnering with entities within the community that continually seek such services as highlighted in the Surgeon General’s Report on Oral Health, in addition to the IOHP. Conclusion: The SIUC DSGP employs the utilization of dental hygiene students under the general supervision of the RDH. The school-based oral health program can serve as one small step towards achieving autonomy in dental hygiene practice.
A Pilot Study of the Effects of a Natural Mineral Dietary Supplement on Gingival Health and Dentinal Hypersensitivity

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Purpose. A natural mineral dietary supplement containing 3.6 mg/liter of fluoride and other minerals (pH 9.6) was studied to determine the effects of drinking the product on dentinal sensitivity and gingival health. The company distributing the supplement, had received unsolicited claims of improvement of oral health and tooth sensitivity from individuals who consumed the product. This pilot study evaluated the clinical validity of the anecdotal claims.

Methods and Materials. Subjects included in the study had minimum levels of dentin sensitivity and gingival inflammation. The investigation was a quasi-experimental pretest design with repeated posttest measurements at four and eight weeks. A randomized, controlled, double-blind approach was used. The experimental and control groups followed the same regimen for drinking and swishing the product, with the only difference being the contents in the bottle (the supplement or a placebo containing de-ionized water). Dentin sensitivity was measured on a visual analogue scale from 0 to 10, using an explorer to determine tactile sensitivity and a blast of air to determine evaporative sensitivity. The Gingival Index (GI) was used to measure gingival inflammation. These data were analyzed using ANOVA and a post-hoc probing technique to determine within and between group differences, at a P=0.05 level.

Results. Both groups experienced a statistically significant decrease in tactile and evaporative sensitivity over the eight-week study; however, the differences between groups were not significant. No significant differences were found in regard to gingival inflammation.

Conclusions. The natural mineral dietary supplement and the de-ionized water were equally effective in reducing dentin sensitivity, and neither product had an effect on gingival inflammation.

Acknowledgements

Funding for this project was provided by the National Medical Device Survey (NMDS).
Kentucky's Oral Health Wellness and Disease Prevention Program: An Innovative Partnership

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Developing unique and varied partnerships to reach at-risk kids and communities is key to tackling current and future oral disease. According to the 2001 Kentucky Children's Oral Health Profiles, in which 5,603 third- and sixth-grade children in Kentucky's public schools were screened, 28.7% had untreated tooth decay. The Kentucky Oral Health Wellness and Disease Prevention Program began with an objective to develop a statewide 4-H camp program focusing on oral health wellness, disease prevention, tobacco education, and the promotion of oral health professions among preteen and teenage campers.

The University of Kentucky College of Dentistry, Division of Dental Public Health, agreed to collaborate with the 4-H program at the College of Agriculture Extension Service by providing a research title faculty member to develop and implement the pilot 4-H camp program for four camps in the summer of 2003. The overwhelming success of the pilot 4-H camp initiative in 2003 led to the program expanding to nine camps in 2004. More notable, however, it precipitated a unique partnership between the two colleges. The jointly appointed faculty member focused on developing oral health wellness and disease prevention resources for extension agents to use on a county-by-county level to educate, promote oral wellness, remove barriers to access, and create a pipeline of oral health professionals from rural communities.

The initial findings of the Kentucky Oral Health Wellness and Disease Prevention Program indicate that networking conducted between non-traditional partners can produce original, expectantly sustainable programs that benefit all counties of the Commonwealth and each family within, while leading the country in innovative approaches to oral health wellness, education, and disease prevention.
Medication Compliance in the Older Adult Patient

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Purpose. The purpose of this study was to determine the level of medication compliance in the older adult dental patient. The ultimate goal of the research was to promote awareness among dental hygiene practitioners of the number of prescription, over-the-counter, and herbal medications used by this population.

Methods and Materials. Self-report questionnaires were distributed randomly to older adults, with the median age range of 76 to 84, attending local community meetings (n=114). All responses were anonymous. A statistical package (SPSS version 12.0, Chicago, IL) was used to execute basic descriptive statistics including frequency distribution, percentages, means, and standard deviations.

Results. Of the 115 surveys distributed, one survey was rejected. Among the respondents, 93% reported taking prescription medication, 63% reported taking over-the-counter drugs, and 23% reported taking herbal medications. Twenty-nine percent took four to six medications daily, and 21% took more than seven medications daily. Nearly one quarter of the respondents surveyed reported that they had missed a dose, while 15% stated that they had stopped taking medication before their prescription was completed. Similarly, 14% responded that they had forgotten to fill or refill a prescription, while 13% stated they had taken less medication than prescribed. Of significance to oral health practitioners, 35% of respondents indicated that their dentists or dental hygienists did not ask them when they last took their medications.

Conclusions. It can be concluded from this study that older adult dental patients are utilizing large numbers of prescription, over-the-counter, and herbal medications; and that medication compliance issues relative to the practice of dental hygiene exist.
Stroke Risk Assessment in a Southeastern University Dental Hygiene Facility

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Purpose. The purpose of this study was to identify significant stroke risk factors, which may assist dental hygiene students in educating the clinic population on methods of stroke prevention. The southeastern United States is referred to as the "Stroke Belt," with Georgia having a 14% higher rate of cardiovascular death and the sixth highest mortality rate among the 50 states. It is postulated that the death rates attributed to this disease are associated with preventable risk factors such as hypertension, diabetes, cigarette smoking, cardiovascular disease, atrial fibrillation, and lack of physical activity.

Methods and Materials. Because statistics reveal a disproportionately high incidence of stroke in this region of the country and risk factors have been identified, this study was conducted on a southeastern Georgia population at the Armstrong Atlantic State University (AASU) campus. The dental hygiene department clinic served as a screening facility for the American Stroke Association’s Southeast Affiliate Operation Stroke project, with services predominately utilized by persons with low income, no insurance, and/or lack of regular health care. Utilizing a written survey for stroke risk assessment and descriptive statistics, data was analyzed to determine age, race, gender, and quantifiable stroke risk factors.

Results. Using one-way ANOVA statistical analysis, the data demonstrated that, of the 144 surveyed, a higher percentage of subjects with a history of diabetes had a moderate stroke risk; whereas a larger percentage of non-diabetics was at low risk. Additionally, subjects who were smokers or had cardiovascular disease or atrial fibrillation were at a significantly greater risk of stroke. Subgroup analyses revealed significant differences between groups in the prevalence of risk factors, suggesting that blacks, even those on blood pressure medicine, had a significantly higher blood pressure (P <.046) than whites. However, because this number of subjects was low (n=5), one should be cautious in drawing conclusions. Additionally, the data indicated no significant differences between gender on any of the risk factors.

Conclusions. Based upon the results, educational information pertaining to stroke risk factors was incorporated into the curriculum in an effort to reduce the stroke incidence in the population utilizing the AASU dental hygiene clinic.
Oral Cancer Prevalence in Virginia

Karin C Loftin, Michele Darby, Stacey Plichta, Sophie Thompson, Shreeram Kumar and Louis Abbey

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Purpose. Oral and pharyngeal cancer affects 30,000 Americans a year and kills one fourth of those diagnosed. The primary risk factors for oral cancer are past or present cigarette and tobacco usage, and alcohol consumption in conjunction with tobacco use. Even though the prevalence of oral cancer is relatively low in the younger age groups, this group is most likely to benefit from intervention programs designed to change risky behavior such as smoking, and to prevent oral cancer in the later years. The goal of the study was to identify high-risk target areas for an oral cancer prevention program in Virginia.

Methods and Materials. The specific objectives were to analyze the 1986 to 2001 Oral Biopsy Database from the Virginia Commonwealth University School of Dentistry for diagnosed cases of oral cancer. To test the hypothesis that Hampton Roads, Virginia would be a high-risk target area, diagnoses were correlated with the 11 zip-code regions in Virginia to identify specific geographical areas with high numbers of oral cancer cases. The oral cancer data set consisted of 4,712 cases. Frequencies and cross-tabulations were calculated for all the variables using Statistical Package for Social Scientists software (SPSS Inc., version 10.1, Chicago, IL).

Results. Results indicated that the Hampton Roads region had the second highest number of squamous cell carcinomas, with 231 total cases. The Richmond area had 435 cases, almost twice as many.

Conclusions. Therefore, Hampton Roads and Richmond are high-risk target areas that would benefit from an aggressive oral cancer prevention and intervention program in its public schools.
Implementing Survey Research into Strategic Planning Activities in Idaho to Advance the Science and Practice of Dental Hygiene

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Purpose. For strategic planning, the Idaho Dental Hygienists’ Association uses survey methodology to identify the opinions and concerns of dental hygienists. This study aimed to assess dental Hygienists’ opinions about advanced dental hygiene practice and legislative activities.

Methods and Materials. In 2002, a coded questionnaire was mailed to Idaho dental hygiene licensees (N = 865). Section I addressed demographic characteristics. Section II surveyed professional concerns, illegal practice, and legislative activities. Respondents were asked to rank 14 professional issues by selecting their top five concerns about dental hygiene practice. Also, respondents were asked if they supported expanding the scope of practice and if they would provide care in alternative practice settings. Data were analyzed using frequency distributions and nonparametric tests of association.

Results. A 60% (N = 519) response rate was obtained after two mailings. Three professional issues were ranked as follows: 1) the national trend to reduce entry-level education (64.9%), 2) dental assistants performing dental hygiene services (61.1%), and 3) legalizing self-regulation (49.8%). Also, 90.9% (n = 460) of respondents supported the expansion of the practice act to improve access to care. Unsupervised practice in public health settings was most important (95.4%), and local anesthesia administration under general supervision was second most important (88.9%). Unsupervised practice in all settings was ranked third most important (85.2%), and providing restorative services was the fourth most important (81.7%) practice act expansion identified. Eighty-nine percent supported having a bachelor’s degree to provide unsupervised care. Data were used to support the 2004 legislation to expand the dental hygiene practice act.

Conclusion. It is vital for state professional associations to utilize information from licensees for strategic planning and legislative efforts. Idaho dental hygienists are concerned about maintaining quality education, expanding access to care to the underserved, providing restorative services, and educating dental personnel about state laws.

Acknowledgements

Funding for this project was provided by an ADHA Kaleidoscope Grant.