Moving Forward...

R Wilder, RDH, BS, MS

Rebecca S. Wilder is an associate professor at the University of North Carolina Chapel Hill School of Dentistry and Director of the Master of Science Degree Program in Dental Hygiene Education. She is the current editor-in-chief of the Journal of Dental Hygiene.

Keywords: peer-reviewed journal, scientific journal, peer review, research journal

Winter is a wonderful time of year. The air is crisp and everyone is ready to learn again. Students fill college campuses and come with the excitement and anticipation of a new adventure. Are you ready for something new? I am excited about the winter edition of the Journal of Dental Hygiene. We are moving forward -beginning with this issue-with some fabulous new sections guaranteed to keep you abreast of the latest science.

Have you ever wondered how you are supposed to keep up with the literature in areas that are pertinent to clinical dental hygiene? Do you ever feel overwhelmed with everything that is available for you to read? How do you know what is really based on science and how it might affect your recommendations to your patients or students? I am pleased to introduce a new section called Linking Research to Clinical Practice. The purpose of Linking Research to Clinical Practice is to present evidence-based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application. Dr. Karen B. Williams will be the ongoing author for this section. Dr. Williams is well qualified to present the evidence to you. She is a professor and director of the Clinical Research Center at the University of Missouri-Kansas City. She received a certificate in dental hygiene and a bachelor's in education at The Ohio State University; a Master's in dental hygiene education at the University of Missouri-Kansas City; and a doctorate in evaluation, measurement and statistics at the University of Kansas. In addition to teaching and research, Dr. Williams has been active in clinical dental hygiene for over 30 years and in clinical research for 20 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health services and health outcomes research, oral manifestations of eating disorders, and clinical dental hygiene. We are so pleased that Dr. Williams has agreed to author this section of the journal. The first area of research that is presented is concerning a topic we have all heard about-adverse pregnancy outcomes and its relationship to periodontal disease.

Do you ever wonder about research that involves dental hygienists? Research Focus is a section you will want to read in every issue of JDH. The purpose of Research Focus is to highlight national and international research being conducted by or involving dental hygienists. Each issue will feature a different research program or activity authored by a different person. I am pleased to introduce the first issue of Research Focus authored by the well respected researcher Dr. Ann Eshenaur Spolarich. Dr. Spolarich received a certificate in dental hygiene from the University of Pennsylvania, a baccalaureate degree in dental hygiene from Thomas Jefferson University, and both a Master of Science in Dental Hygiene
and a doctorate in Physiology from the University of Maryland at Baltimore. Dr. Spolarich has conducted research at Johns Hopkins Hospital, Thomas Jefferson University Hospital, University of Maryland Cancer Center, University of Maryland Dental School, Philadelphia VA Medical Center, and the National Office of Veterans Affairs in Washington DC. She is Chair of the ADHA Council on Research and is also the ADHA liaison to the NIDCR Dental Practice Based Research Networks project, the focus of this first edition.

As someone who has made a career in academics, educational endeavors are an important focus of my professional life. *Innovations in Education and Technology* will feature short reports of innovative teaching applications and techniques as well as new technologies available for increased communication and learning in dental hygiene education. I invite any dental hygiene educator to share innovations in their program with others through this new initiative. The first author for *Innovations in Education and Technology* is a long time academician, **Ms. Jacquelyn Fried.** Ms. Fried received a Bachelor of Arts degree in political science and a certificate in dental hygiene from The Ohio State University. She also holds a Master of Science in dental hygiene from Old Dominion University. Ms. Fried is currently an associate professor and director of the dental hygiene program in the Department of Health Promotion and Policy at the University of Maryland Dental School. Ms. Fried is very well known for her research, didactic, and community activities related to tobacco. She conducted some of the original research on the dental hygienist's role in tobacco prevention and cessation. She is an active member of ADHA and serves on the ADHP and Tobacco task forces. She also chairs the Tobacco-free Special Interest Group for the American Dental Education Association. However, her newest interest areas are in the technological aspects of teaching and learning. This first edition of *Innovations in Education and Technology* will feature new innovations that have been implemented at the University Maryland Dental School in the area of technology.

Let me hear from you. Tell me how you like the new sections and what you want to learn more about. Email me at RebeccaW@adha.net

Have a happy and joyous 2007!

Sincerely,

Rebecca Wilder, RDH, BS, MS

Editor-in-Chief, *Journal of Dental Hygiene*
Review of: Radiology For The Dental Professional

Joan Gibson-Howell, RDH, MSEd, EdD

Reviewed by Joan Gibson-Howell, RDH, MSEd, EdD, assistant professor, The Ohio State University, Columbus, Ohio.

Radiology For The Dental Professional

Eighth Edition

Frommer HH, Stabulas-Savage JJ

Elsevier Mosby, 2005

St. Louis, Missouri

576 pages; illustrated; indexed; softcover

ISBN: 0-323-03071-8

$59.95

Since 1975 Dr. Frommer, BA, DDS, FACD, has consistently produced an excellent resource for dental professionals in radiology. The eighth edition of this publication is an affirmation of its usefulness and practicality. In the preface, Dr. Frommer stated he has strived to “stay true to the original mission of the book to apply basic principles to clinical practitioners.” Thirty years of publications attests to his commitment.

Improvements in new editions are expected. Therefore, there are 3 changes in this publication. One change is the expansion in text title, Radiology For The Dental Professional, which reflects a broader readership of all dental professionals. The second change is an expansion of chapters and chapter content. This change supplied additional illustrations; the rearranging of chapter information made significant improvements for all levels of radiology learners. For example, an added feature is that each chapter is deliberately organized to correlate to a one-hour lecture. For the novice or the experienced teacher, this superb feature assists in developing the quarter or semester course schedule and maintaining the credit hour/clock hour schedule. With so much information to share, this is an excellent asset. Thirdly, Dr. Frommer has added of a coauthor, Ms. Stabulas-Savage, RDH, BS, MPH, a dental hygienist. Congratulations Ms. Stabulas-Savage and Bravo Dr. Frommer! What a team-so resourceful and practical.

Each chapter begins with an outline, 1 to 3 educational objectives, and key words. The key words are also italicized within the chapter readings to further understand the term within context. In addition, a 21-page glossary at the end of the chapters helps to further define new or review terms. Whether the reader is learning or reviewing the language, techniques, and concepts, the level of reading and comprehension is appropriate. The numerous figures and procedure boxes in each chapter serve to enhance the understanding of techniques, positions, and common errors. Within chapters, common errors in exposing, processing, and interpreting is clearly delineated with sections as appearance, error and cause, resultant image, and remedy. These areas are helpful to the new learner and a quick review for the practitioner.
The chapter entitled Ionizing Radiation and Basic Principles of X-Ray Generation addressed a topic that is typically challenging to master. Yet, this chapter read like a story and removed the threat of the "over my head" feeling. In fact, it was quite enjoyable. The chapters discussing techniques included procedure boxes that specifically identified point of entry, vertical and horizontal angulation, chair position, and film position for each projection and exposure. A specific area of this procedure box called "helpful hints" provided the student and practitioner with a suggestion to enhance the radiograph or assist the patient during exposure. The text purports the paralleling technique as the method of choice because it produces accurate diagnostic images, less exposure to the patient, and is easily standardized. The figures in each chapter clearly illustrate the technique along with ancillary techniques to use as needed. A digital radiography chapter with explanations and figures provides the learner with basic information to delineate the types of digital units. I applaud the authors on presenting information in separate chapters regarding patient protection, operator protection, quality assurance, and legal considerations. For enhancements, a chapter is included regarding the temporomandibular joint and advanced imaging systems. Although the majority of the radiographs were of high quality, some lacked the image detail and contrast important to diagnosis, but were adequate to demonstrate the detail within the context of the chapter.

With the current competition in radiology texts, this publication continues to present the basic information in a unique way that enhances understanding. It can be used as the primary text or as a reference for the practitioner or teacher to learn to say and do things in different ways for the dental professional and the dental patient.

Christine Nathe, RDH, MS

Reviewed by Christine Nathe, RDH, MS, professor and graduate program director, University of New Mexico, Division of Dental Hygiene, Albuquerque, NM.

Fundamentals of Operative Dentistry: A Contemporary Approach

Third Edition

Summitt JB, Robbins JW, Schwartz RS

Quintessence Books, 2006

Hanover Parks, Illinois

599 pages; illustrated; indexed


$95.00

Fundamentals of Operative Dentistry: A Contemporary Approach is a textbook written for dental students and dental providers with current and practical concepts of prevention and management of caries as a disease and of restoration of individual teeth. The inherent theme in the textbook is that of contemporary operative dentistry. The authors have incorporated the advances in material, instruments, and dental adhesives throughout the textbook. They explain that many times in operative dentistry procedures are based on history and tradition and not necessarily by science. In the preface there is discussion on Dr. GV Black’s classic theories on operative dentistry.

The authors theorize that if the founder of modern dentistry were alive today, he would be leading the advances of new technology and innovation, and would not be clinging to concepts of the past.

This textbook covers assessment, diagnosis, and treatment planning strategies for dental caries. Pulpal considerations, instrumentation, and isolation are discussed and bonding, anterior, and posterior restoratives are presented. Special emphasis is directed at fluoride-releasing materials, bleaching, and class V restorations. Crowns, veneers, inlays, and onlays are presented along with the dental materials selections.

Several themes are presented throughout the textbook. The first is the attempt to provide a scientific basis for the concepts. In fact, when convincing evidence is not available, the textbook presents a consensus founded on a significant depth of experience and informed thought. This edition has been updated with new information based on evidence reported since the second edition.

A second theme reflected in the book is the commitment to conservative dentistry. In fact, the treatment modalities described involve the preservation of as much sound tooth structure as possible within the framework of the existing destruction and
the patient's expectations for esthetic results. As a dental hygienist, it is enlightening to see such emphasis placed in preventive operative dentistry.

References are included in each chapter. Throughout the book, there are numerous colored photographs and diagrams, some in black and white and some in color. These photographs and diagrams are outstanding! The textbook is indexed and contains figures and tables throughout the chapters. This book is easy to read and understand. The use of photographs and diagrams and accompanying descriptions make for a well-written college textbook! Although, this book is recommended for dental students and dentists, it would be a great resource for a dental hygiene faculty member teaching a dental biomaterials or clinical course.
Review of: Dental Embryology, Histology, and Anatomy

Diane P Kandray, RDH, M.Ed

Reviewed by Diane P. Kandray, RDH, M.Ed., Assistant Professor, Dr. Madeleine Haggerty Dental Hygiene Program, Youngstown State University, Youngstown, Ohio

Dental Embryology, Histology, and Anatomy


Mary Bath-Balogh
Margaret J. Fehrenbach
Elsevier Saunders, 2006
St. Louis, Missouri

403 pages, illustrated and indexed; softcover


$55.95

Dental Embryology, Histology, and Anatomy by Mary Bath-Balogh and Margaret J. Fehrenbach is a textbook on oral biology for the dental professional. The text is divided into four units: Introduction to Dental Structures, Dental Embryology, Dental Histology, and Dental Anatomy. The first unit includes recognition of intraoral and extraoral anatomical landmarks. The second unit on dental embryology begins with prenatal development and ends with tooth development and eruption. The dental histology unit covers the development of all oral tissues including oral mucosa, enamel, dentin, cementum and pulp. Finally, the dental anatomy unit covers the primary and permanent dentition, the temporomandibular joint and occlusion. Each unit is comprised of several chapters; all 20 chapters begin with objectives, an outline, and key terms. The text is divided so that each unit can stand alone or be incorporated into a varied curriculum.

The outstanding features of this book are the over 700 color photographs and illustrations. This is a noticeable improvement over the previous edition. Color images are particularly helpful in the dental histology unit featuring color photomicrographs of oral tissues. Color photomicrographs are particularly helpful because they enable the reader to more easily discern microscopic structures. Each chapter contains numerous boxes of information and tables that describe in more detail specific dental conditions. The information in these boxes not only provides interesting facts for the reader, but important relevant information that clarifies essential concepts. This edition also includes current information on the inflammatory and immune response, as well as updated information on furcations, pulp morphology, removal of third molars, and more.

Each topic is organized and covered adequately for the dental hygiene curriculum. For example, there is enough background information on the cell for students to comprehend basic cell division and reproduction, and progress to basic tissues of the oral cavity. The dental anatomy unit is also a highlight of the text. Tooth morphology is covered thoroughly, using
new photographs and diagrams to illustrate developmental disturbances and anomalies. The addition of key terms and the phonetic pronunciation of selected vocabulary words at the beginning of each chapter are extremely useful.

The use of the Evolve Resources web-site is available exclusively to textbook users. Evolve provides online access to PowerPoint slides, a test bank, case studies, updates of new clinical concepts, and supplemental study materials. The web-site is beneficial to both the instructor and student. Use of this technology is designed to enhance the presentation of material and interaction with students. A workbook and instructor's resource manual are available separately. The workbook is highly recommended for students, featuring case studies and review exercises. The instructor manual is also suggested as a helpful teaching aid that includes classroom activities, a test bank and reproducible tables from the textbook.

Finally, the level of writing is suitable for dental hygiene students. The chapters are interspersed with photos, diagrams, illustrations, radiographs and tables to divide the reading into manageable segments. This is unquestionably an essential textbook for dental hygiene students. Dental hygiene instructors will find this comprehensive textbook valuable for dental anatomy and histology instruction.

Margaret J Fehrenbach, RDH, MS

Reviewed by Margaret J. Fehrenbach, RDH, MS, dental hygiene educational consultant, Seattle, WA

Manual of Minor Oral Surgery for the General Dentist

Koerner K

Blackwell Publishing Professional, 2006

Ames, Iowa

336 pages; illustrated; indexed; softcover

ISBN: 0-81380-559-7

$119.99

The purpose of the Manual of Minor Oral Surgery for the General Dentist is to be a guide to performing common surgical procedures in the dental office. The text, written by various dentists and then edited by a published oral surgery author, is a collection of short chapters on a variety of procedures. Since it is in its first edition, it can be forgiven for its sometimes folksy use of "in our office..." and "a good hygienist should..." throughout the text. Many chapters have an overlap of information, which can be expected in such a collection, and some have a difficulty in organization of background material, such as the chapter on sedation. However, the overall language is easily read by the dental practitioner. Each chapter has references that could be read for more information since each is a landmark article on the subject. Finally, the text emphasizes the patient and the associated responsibility of the practitioner to meet the needs of that patient.

The information presented is up to date and includes recent information on oral cancer diagnostic procedures, blood pressure concerns, and HIPPA basics. However, the chapter on patient evaluation should consider the use of the ASA Physical Classification system to better inform the reader when discussing patient risk.

The use of clear clinical photographs and useful diagrams of the surgical procedures, with condensed notes for each common surgical procedure (most step-by-step), really helps to enlighten the dental practitioner. The outstanding chapter on surgical crown lengthening is sure to aid the dental hygienist in understanding this important procedure for pocket maintenance. As an example, it rightly emphasizes the topical use of CHX postoperatively in the localized area, noting the complications of stain and calculus formation when used as a general rinse.

In addition, the extensive chapters on third molar extraction and endodontic surgery are a must read for informing patients who need these procedures. Especially noted were the indications discussed for the need for third molar extraction. The chapter on the evaluation and treatment of oral lesions is a good review for the practicing dental hygienist.

The information presented on sedation demonstrates the care required for its use and may be a good topic for in-office discussion. So, too, are the techniques discussed on the management on perioperative bleeding, which is a top continuing
concern for most dental practices that perform minor surgical procedures on a daily basis. It includes a discussion of the over-the-counter herbs that are related to an increased risk of bleeding by the patient.

The chapter on Third World Dentistry is interesting and may be useful for those dental hygienists looking to make a difference worldwide.

This text would be a great addition to the reading library of the practicing dental hygienist and/or dental hygiene school. Also, it would be a text that one could strongly recommend to the general dentists because it more than succeeds in its goal as a manual for common oral surgical procedures.
Research Focus

Ann E Spolarich, RDH, PhD

NIDCR Dental Practice Based Research Networks

In March of 2005, the National Institute for Dental and Craniofacial Research (NIDCR) awarded 3 7-year grants, totaling $75 million, to establish regional dental practice-based research networks (PBRN) to investigate clinical problems of interest to dentists and dental hygienists working in private practice. The grants were awarded to New York University, University of Alabama, and the University of Washington. University of Florida is working cooperatively with the University of Alabama, and Oregon Health Sciences University is working cooperatively with the University of Washington.

Each of these regional networks will train approximately 100 dentists to perform clinical research studies within their practices. The networks will include practitioners in their own states, as well as from surrounding states. This approach to research is unique, in that it allows for the conduct of high quality clinical research by dentists and dental hygienists in the private practice setting, where they will be able to investigate everyday problems and topics of importance to practitioners. These studies will provide data that will help to guide treatment decisions in the dental office, an effort that supports evidence-based practice.

Practitioners apply to become members of the research network and work directly with the project team experts at the university. Applicants receive training in research protocols, human subjects’ protection, and study monitoring. Practitioners submit their own ideas for clinical studies, and when approved, experts design the appropriate trial. Then, practitioners in the network implement the study in their practices. Analysis of the data and tabulation of the results will be conducted by experts at the university. Study findings will be disseminated at professional meetings and in publications in the scientific literature.

It is anticipated that each regional network will conduct approximately 15 to 20 short-term clinical studies over the next 7 years. Studies will investigate dental procedures, dental materials, and prevention strategies in a wide variety of populations and clinical circumstances. The networks will also conduct retrospective chart reviews, in accordance with HIPAA, to investigate disease patterns, prevalence of oral diseases and disorders, and treatment trends.

At the ADHA Annual session in Orlando, 2 members from the University of Alabama PBRN network project team gave a presentation at the Research Conference. They encouraged dental hygienists in their geographic region to submit ideas for clinical studies for consideration by the network, and to participate in their studies. As the ADHA liaison to this NIDCR project, I commend the University of Alabama for reaching out to the dental hygiene community and encouraging our participation. This project is an excellent opportunity for dental hygienists to become involved in clinical research. This is a well-coordinated effort involving NIDCR, universities, established investigators, and practitioners in a model approach that encourages collaboration. It is a rare and unique chance to be able to participate in a funded study that involves our own patients in the settings where we practice. This is a great time to pursue your interest in research and get started right in your own backyard.

Dental hygienists who are employed by dentists who are participants in a PBRN, and/or those who are interested in participating, should contact the appropriate network within their regions for additional information. The Web sites for each of the networks is listed below.
Linking Research to Clinical Practice

Karen B. Williams, RDH, PhD

Karen B. Williams is a Professor and Director of the Clinical Research Center at the University of Missouri-Kansas City. She received her Certificate in Dental Hygiene and B.S. in Education at The Ohio State University, her M.S. in Dental Hygiene Education at the University of Missouri-Kansas City, and Ph.D. in evaluation, measurement and statistics at the University of Kansas. Dr. Williams has been active in clinical dental hygiene for over 30 years and in clinical research for 20 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health services and health outcomes research, oral manifestations of eating disorders, and clinical dental hygiene. She is a research consultant for numerous dental manufacturers. Dr. Williams has presented papers and continuing education programs throughout the United States and internationally.

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

Progressive periodontal disease and risk of very preterm delivery


Department of Periodontology, Center for Oral and Systemic Diseases, University of North Carolina School of Dentistry, Chapel Hill, North Carolina 27599-7455, USA. steve_offenbacher@dentistry.unc.edu

Abstract

Objective. The goal was to estimate whether maternal periodontal disease was predictive of preterm (less than 37 weeks) or very preterm (less than 32 weeks) births.

Methods. A prospective study of obstetric outcomes, entitled Oral Conditions and Pregnancy (OCAP), was conducted with 1,020 pregnant women who received both an antepartum and postpartum periodontal examination. Predictive models were developed to estimate whether maternal exposure to either periodontal disease at enrollment (less than 26 weeks) and/or periodontal disease progression during pregnancy, as determined by comparing postpartum with antepartum status, were predictive of preterm or very preterm births, adjusting for risk factors including previous preterm delivery, race, smoking, social domain variables, and other infections.

Results. Incidence of preterm birth was 11.2% among periodontally healthy women, compared with 28.6% in women with moderate-severe periodontal disease (adjusted risk ratio [RR] 1.6, 95% confidence interval [CI] 1.1-2.3). Antepartum moderate-severe periodontal disease was associated with an increased incidence of spontaneous preterm births (15.2% versus 24.9%, adjusted RR 2.0, 95% CI 1.2-3.2). Similarly, the unadjusted rate of very preterm delivery was 6.4% among women with periodontal disease progression, significantly higher than the 1.8% rate among women without disease progression (adjusted RR 2.4, 95% CI 1.1-5.2).
Conclusion. The OCAP study demonstrates that maternal periodontal disease increases relative risk for preterm or spontaneous preterm births. Furthermore, periodontal disease progression during pregnancy was a predictor of the more severe adverse pregnancy outcome of very preterm birth, independently of traditional obstetric, periodontal, and social domain risk factors.

Commentary

Newborns delivered preterm have higher levels of morbidity that may impact them throughout life. Recently, studies have begun to explore factors that are associated with preterm delivery. Many retrospective case-control studies have suggested a relationship between periodontal disease and preterm delivery and/or low birth weight babies. However, retrospective studies do not allow conclusions to be made about whether the potential cause (in this case periodontal disease) precedes the outcome (preterm delivery). This study is one of the first studies to report findings obtained during a large, prospective study (the Oral Conditions and Pregnancy study-OCAP). Prospective study designs provide a higher level of evidence since it is possible to assess whether the potential cause was present before the outcome occurred. This team of researchers examined the impact of preexisting periodontal/gingival disease and progression of disease during pregnancy on 2 important pregnancy outcomes: preterm delivery (defined as less than 37 weeks gestation); and, very preterm delivery (defined as less than 32 weeks gestation). The results suggest that the presence of periodontal disease (measured as none, mild or moderate/severe at a point prior to 26 weeks gestation) is a significant risk factor for preterm birth (<37 weeks gestation), and that this effect is independent of other known risk factors such as previous preterm pregnancies and chorioamnionitis (an inflammatory condition of the uterus during pregnancy, usually caused by a bacterial infection). It is particularly interesting that sexually transmitted diseases were not found to be related to preterm delivery, suggesting that the effect of oral infections is distinctly different than reproductive tract infections. Disease progression (defined as ≥4 sites with an increase of 2mm or more during the pregnancy) was a significant factor for very preterm delivery (<32 weeks gestation) but not for preterm delivery (<37 weeks). In spite of this compelling evidence, it is still unknown whether the presence of periodontal disease has a causative effect on preterm delivery or whether women who have preterm delivery as well as periodontal disease might have an underlying intrinsic inflammatory or innate immunity trait that predisposes them to both conditions. No attempt was made to link periodontal organisms with those found in the uterus of women with chorioamnionitis. Irrespective, these early associations between periodontal disease and preterm delivery have implications for dental hygienists in preconception and early pregnancy counseling.

Fusobacterium nucleatum induces premature and term stillbirths in pregnant mice: implication of oral bacteria in preterm birth


Department of Periodontics, School of Dental Medicine, Case Western Reserve University, Cleveland, Ohio 44106-4905, USA. ywh2@case.edu

Abstract

Fusobacterium nucleatum is a gram-negative anaerobe ubiquitous to the oral cavity. It is associated with periodontal disease. It is also associated with preterm birth and has been isolated from the amniotic fluid, placenta, and chorioamnionic membranes of women delivering prematurely. Periodontal disease is a newly recognized risk factor for preterm birth.

Objective. This study examined the possible mechanism underlying the link between these two diseases. F. nucleatum strains isolated from amniotic fluids and placentas along with those isolated from orally related sources invaded both epithelial and endothelial cells. The invasive ability may enable F. nucleatum to colonize and infect the pregnant uterus. Transient bacteremia caused by periodontal infection may facilitate bacterial transmission from the oral cavity to the uterus.

Methods. To test this hypothesis, we intravenously injected F. nucleatum into pregnant CF-1 mice.
Results. The injection resulted in premature delivery, stillbirths, and nonsustained live births. The bacterial infection was restricted inside the uterus, without spreading systemically. F. nucleatum was first detected in the blood vessels in murine placenta. Invasion of the endothelial cells lining the blood vessels was observed. The bacteria then crossed the endothelium, proliferated in surrounding tissues, and finally spread to the amniotic fluid. The pattern of infection paralleled that in humans.

Conclusion. This study represents the first evidence that F. nucleatum may be transmitted hematogenously to the placenta and cause adverse pregnancy outcomes. The results strengthen the link between periodontal disease and preterm birth. Our study also indicates that invasion may be an important virulence mechanism for F. nucleatum to infect the placenta.

Commentary

This study is one of the first to examine the potential mechanism by which periodontal organisms may affect adverse pregnancy outcomes such as preterm delivery. An innovative mouse-model design was used to determine if Fusobacterium nucleatum, a common organism associated with periodontitis, can invade the placental barrier. F. nucleatum was selected as the organism to examine in the study as previous research has shown that it can be isolated from the blood stream of individuals with periodontal disease. Relying on Koch’s postulates for proof of association, the researchers isolated several strains of F. nucleatum from the oral cavity of women who had prematurely delivered their babies, cultured these strains, and injected various concentrations into pregnant mice at the gestation phase equivalent to 28 and 32 weeks in human gestation. Two additional solutions (containing E. coli, which is known as a non-invasive microbe, or a phosphate-buffered saline) were injected into other pregnant mice to serve as 2 controls. Preterm births, still births, and fetal death rates were high in the mice that had been injected with F. nucleatum. In contrast, all mice injected with either the E. coli solution or phosphate-buffered saline delivered normal, healthy mice pups.

In a parallel study conducted at the same time, pregnant mice were again injected with F. nucleatum and live organisms obtained from their spleen, liver, and placenta 6 hours after the injection. At 24 hours post injection, the microbes were not detectable in the liver or spleen, suggesting they had been eliminated from both organs, but they had established stable colonization in the placenta. Given that Koch’s postulates for establishing causation were met, the authors concluded that F. nucleatum is a causative agent for adverse fetal outcomes and these outcomes are analogous to those found in humans. Additionally, immunohistochemical analysis of placental tissue was conducted to determine where the organisms were located at 24, 48, and 72 hours following injection of either the F. nucleatum or control solution. These analyses showed that the organism cultures penetrated the endothelia and were capable of infecting the placental membranes, similar to chorioamnionitis in humans after 72 hours.

It is important to note that the researchers did not attempt to make the bacterial challenge given to the pregnant mice equivalent to that which would be found in bacteremia of periodontal origin in humans. While the study does substantiate a causative link between the organism injected at high levels and preterm birth and fetal death, the results must be considered in light of the methodology used. As a "proof of concept," the study provides the evidence that may facilitate our understanding of the relationship between periodontal organisms and preterm delivery or adverse pregnancy outcomes. However, caution must be used in generalizing these results to humans since the concentrations of F. nucleatum solutions intravenously injected into the mice were very high and are not comparable to those found in periodontally related bacteremia. Additionally, only one organism was examined in this study.

The Bottom Line

Although much attention has been given to the possible role that periodontal disease may play in adverse pregnancy outcomes, the evidence showing a causative link is still lacking. The 2 studies reviewed above represent some of the best "early evidence" available to date; however, there are still many unanswered questions that need to be addressed before researchers and clinicians alike can substantiate a causative relationship. Based on this critical appraisal, the following conclusions and recommendations can be made to clinicians:
• The rate of preterm delivery (<37 weeks) in this sample of pregnant women who were receiving prenatal care at Duke University's Obstetric Clinic was 11.2% for periodontally healthy individuals, 19.0% for women with mild periodontal disease, and 28.6% for women with moderate-severe disease. Data for other populations may vary from these estimates.

• "The increased risk for preterm delivery was 1.6 times greater for individuals with moderate-severe periodontal disease compared to periodontally healthy women.

• Pregnant women who had progressive periodontal/gingival breakdown during their pregnancy were 2.4 times more likely to have very preterm delivery (<32 weeks gestation).

• It is unknown whether periodontal disease predisposes women to preterm delivery or whether some underlying immunological or inflammatory defect makes women predisposed to both conditions.

• At least one periodontal organism has been shown, using an animal model, to be capable of invading vascular cells and being transmitted to the placental tissues in pregnant mice.

• The animal model "proof of concept" results are likely not directly relevant to periodontally induced bacteremia in pregnant humans since the concentration of bacteria was high and directly injected intravenously into pregnant mice.

• These study results do not provide any guidance as to what is the best clinical intervention to follow when providing dental hygiene care to pregnant women with periodontal disease. However, preconception oral health care and counseling is warranted and in line with current guidelines for reducing risk factors (in this case chronic infection) in women prior to conception.

Summary

Until additional evidence is obtained on the role of periodontal disease in pregnancy outcomes AND how best to treat pregnant women with disease, the best course of action for the dental hygiene clinician is to provide pre-conception care aimed at reducing and controlling gingival/periodontal inflammation. In the absence of preconception care, early pregnancy counseling should be aimed at empowering the pregnant women to employ good plaque control through an understanding of how hormones play in exacerbating existing disease. Use of scare tactics (attributing potential adverse pregnancy outcomes to periodontal disease) should be avoided as there is insufficient evidence to date.
Innovations in Education and Technology

Jacquelyn L Fried, RDH, MS

Ms. Jacquelyn L. Fried is Associate Professor and Director of the Dental Hygiene Program in the Department of Health Promotion and Policy at the University of Maryland Dental School. She received a Bachelor of Arts degree in political science and a Certificate in Dental Hygiene from the Ohio State University. She also holds a Master of Science in Dental Hygiene from Old Dominion University. She has been in dental hygiene education for almost thirty years. Ms. Fried is known internationally for her involvement in research, didactic and community activities related to tobacco. Recently she has initiated investigations into the technological aspects of teaching and learning. Ms. Fried is widely published and has authored numerous manuscripts and book chapters. She has been honored for her teaching abilities and is a recipient of The Warner Lambert (now Pfizer)/American Dental Hygienists' Association Award of Excellence.

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

Dental Hygiene Education: New Horizons in Technology

A key force in advancing a profession is the quality of education its members receive. The formal dental hygiene educational process begins with entry level programs. Thus, the provision of quality education primarily rests with dental hygiene educators. New challenges confront the dental hygiene educator of today. Specifically, dental hygiene educators must consider the characteristics of today’s students and develop effective teaching strategies to meet their needs.1

Society is in the midst of a technological boom that has profound effects on how faculty teach and students learn.1,2 Dental hygiene education is not immune to these developments and already is responding to critical external forces by offering online courses and computer-based learning activities.3 The students of today are raised in a world of computers, high-speed internet, instant messaging, and iPods, and the list of new technologies to which they are exposed continues to grow exponentially.1,4 To be effective, dental hygiene educators must acknowledge the "millennium" students of today and provide learning options that mesh with their orientations and needs.

"Millennials" are students born after 1980 who are described as possessing definitive value systems. Typically, they are inclusive and tolerant of others, hard-working, team-oriented, and structured.4 Millennials believe that multitasking is efficient, not inconsiderate. Everyday life for them includes checking emails, blogging, viewing videos on their cell phones, and accessing remote sites. They shop on eBay, access information through Google, and "talk" to friends on different continents instantaneously. These students are used to getting what they want when they want it; in other words, quick access.1,4 The act of quickly accessing and using information is universal; however, when and how this behavior takes place can be very individualized. For example, one student may prefer to shop on eBay at 3:00 AM while another may purchase an item at 12 noon. Instant access allows for self-paced activity—a clear opportunity for the dental hygiene educator.

Computer technology avails students to remote site learning.1,4 Globalization permits a student in the United States to access a course offered at an African university. Students today learn from the comforts of their living room couches while...
still wearing their pajamas. A culture of multi-tasking enables students to walk down the street and send an email simultaneously. MP3 players play music and show movies. Students can brush their teeth while learning their dental anatomy.

Addressing the learning needs of the sophisticated student of today is challenging but doable. Many different types of electronic technology have been developed and are available for teaching the millennials. Reports indicate that electronic learning is not a panacea.\textsuperscript{3,7} Diminishing a sense of isolation and maintaining a community of students is particularly challenging.\textsuperscript{5} However, keeping pace with today's advances and catering to the characteristics of the new learner is incumbent upon institutions of higher learning.

\textit{Innovations at the University of Maryland School of Dentistry Division of Dental Hygiene}

Remote Site Teaching

The Division of Dental Hygiene at Maryland has been fortunate in that the deans and administration have provided strong support for its program. The University of Maryland, Baltimore's (UMB's) previous Dental School Dean Dr. Richard Ranney proposed an increase in the dental hygiene class size, and in 2005, this vision became a reality under UMB's current Dean Dr. Christian Stohler. At UMB, the entering classes of 2005 and 2006 include 8 more students than the number admitted in Fall 2004.

The vision to increase the number of UMB graduates came to fruition for a variety of reasons. First and foremost, was the realization that there was an increased demand by students to enter the dental hygiene profession. It also became clear that there was a particular need for more dental hygienists on the eastern shore of Maryland and the students in that region were expressing an interest in pursuing a dental hygiene degree. Maryland dental practitioners, the Eastern Shore Dental Society, nondental health professionals, and the citizenry of Maryland verbalized the desire for Maryland to graduate more dental hygienists.

Taking all these factors into account and realizing the capabilities offered by a new state of the art facility, the practicality of starting a remote site dental hygiene program on the eastern shore was within reach.

Geographically, the eastern shore of Maryland is separated from the rest of the state by the Chesapeake Bay. From some areas of the eastern shore, the commute to Baltimore (ie, the UMB Dental School) can take more than 3 hours. While many eastern shore students have expressed an interest in pursuing a career in dental hygiene, many students opted not to apply to the UMB program due to the distance and time involved to participate.

The division initiated dialogue with 2 community colleges on the eastern shore of Maryland to determine if a collaborative relationship could be developed. Negotiations between these 2 entities and the Division of Dental Hygiene began in 2004 and a Memorandum of Understanding (MOU) was reached in 2005. To lay the groundwork, a preprofessional dental hygiene Associate of Science (AS) curriculum was established at the 2 eastern shore institutions. The MOU stipulated that students would pursue a pre-professional dental hygiene degree and then, upon completion of their professional studies, be conferred a baccalaureate degree in Dental Hygiene from the University of Maryland. For the professional education piece, didactic courses would be delivered online and clinical experiences would occur at a clinical facility on the eastern shore. Therefore, in addition to increasing the class size at the UM campus, beginning in Fall 2006, additional students will begin their dental hygiene studies online and obtain clinical education at a remote site on Maryland's eastern shore. This satellite program initially will accept 4 "first year" students and hopefully expand to 10 new students at the junior level starting in Fall 2007.

The New Building

The 2006 opening of a new state-of-the-art dental school in Baltimore is the key factor that allowed the curriculum transformation to online learning and hence, accessibility for eastern shore students. In the late 1990s, a bill funding the new dental school facility was passed by the Maryland State Legislature. The building has been designed to house cutting edge technology that will address the needs of the millennial student and will mesh with remote site learning. The technology will allow video-conferencing, online testing, utilization of software that enables students to "hear and see" their faculty,
and sophisticated communication channels to ensure that dental hygiene students, regardless of where they live and study, will share identical curriculum and learning experiences.

The New Technology

It is important to note that many different types of electronic technology are available for teaching the "millennials." The configuration used at the University of Maryland is one methodology. In describing the Maryland approach, emphasis will be placed on the ways this technology fosters effective teaching and learning. Ultimately, it is the appropriate application and usage of technological teaching methods that determines their effectiveness. The packaging of technology, ie, how the different components interconnect, is an important aspect of enhanced learning.8

On some level, many dental hygiene educators are utilizing e-learning.3 Many institutions provide online teaching modules that allow student access to information 24/7.3 The UM configuration fosters self-paced, self-directed learning by offering a broad scope of technologies that enable students to access information in multiple environments. Basically, the software that UM employs allows students to access learning modules and resources via their laptops at home, in the school's clinical environments, and in the simulation settings. The school's intranet connects all simulation areas to each other and allows the user to call up the same software there as in the clinic.

The Simulation Environment

The simulation environment provides students with preclinical experiences and offers a seamless transition to the clinical setting. Simulation work stations are equipped with phantom patients (Figures 1,2) that promote operator ergonomics (Figures 3,4), an instrument console identical to that provided in clinic units, and mounted flat panel displays and computers.9 When in this environment, on their screen, students are able to access a simulated electronic patient record (EPR) of choice and essentially use the information to provide treatment to the phantom (simulator) patient. This treatment is identical to the care rendered to a real patient. (Figure 5) This simulation opportunity allows the student to prepare for the actual clinical patient treatment. Online information (eg, pathology, anatomy) related to the patient’s care can be accessed at any time to facilitate development of an in-depth and effective treatment plan.

Figure 1: Provider with Phantom Patient
Video-superimposition software in the simulation areas allow an intra-oral camera, which is attached to the simulation station, to capture an image (eg, student instrumentation) and then permit that image's superimposition on top of the ideal.
In essence, the student's instrumentation visually appears on the screen with the ideal as a comparison. This technology facilitates students' self-assessment of their instrumentation skills and enables real time visual learning. Mobile "X-ray" boxes also are available in the simulation area. Students can place the mannekin typodonts into a cradle that houses a digital sensor, permitting the simulation of digital radiography.

Some simulation units are equipped with haptic devices (Figure 6). Haptic is derived from the Greek word *haptikos* (to grasp or touch) and is defined in English as "tactile or anything related to the sense of touch." Incorporated into haptic devices are tactile cues (e.g., the bumpiness of calculus) as well as kinesthetic cues (e.g., the resistance of the tooth enamel). By controlling the movement of the selected instrument (e.g., explorer, curet, etc.) through the use of a small lever mounted on the haptic hardware, the student learns to differentiate between calculus and tooth structure. With these built in cues, the student can learn scaling on a virtual tooth and learn and discern the different textures of calculus and tooth structure. The way in which the student manages the instrument's movement through the use of the pod handle is projected onto the computer monitor. By watching the monitor, the student can modify his or her "navigation" of the instrument and learn ideal angulation, grasp, exploratory, and activation strokes. Student self-assessment is built into this approach. The student can switch between various instruments at will; this freedom promotes self-paced learning and facilitates students' achievement of preclinical competency.

Other features of the combined haptic technology and a digitized system include remote faculty access to students' virtual instrumentation and student access to video superimposition when using the haptic device (Figure 6). Remote site access for faculty observation allows faculty to assess students' instrumentation skills from beginning to end, something often traditionally difficult for faculty to accomplish. Students receive concentrated individualized attention, including both "process and product" evaluation. Close monitoring by faculty helps pinpoint students needing additional assistance. This monitoring also can facilitate equitable distribution of faculty; the students needing the most help will have greater faculty coverage than those who do not.

Through the school intranet system, all simulation units are networked to each other and to all teaching stations, allowing student to student, faculty to faculty, and student to faculty communication. With the use of microscopes, this networking
system also allows faculty to stream magnified images to all students simultaneously in real time. The benefits of the microscope for teaching purposes are many. First, faculty can project images that are many times larger than the object's actual size; thus, difficult concepts for students to visualize such as proper curette angulation are understood more readily. Microscopes vary in their enlargement capacity. Images can be up to 10 times larger than they really are. Simultaneous visualization supports group questions and enables the immediate provision and demonstration of accurate feedback. Video cameras mounted on the microscope also allow students to tape themselves practicing instrumentation. These images can be displayed for student and faculty review at any time.

Web cam technology also allows for remote monitoring of students in the simulation areas and clinics anywhere in the building. Since all simulator stations and dental chairs are interconnected via the internal building network, a student can be monitored at any time in both environments. Web-camera viewing angles can be adjusted from wide-angle to close up. These different perspectives allow faculty to see the whole person or the actual task being undertaken; "hands only." Scrupulous monitoring of psychomotor skills allows for early identification of problems. Since equipment in the simulation area and the clinic are identical and all software is available at both teaching sites, essentially, the simulation area becomes a "virtual classroom." The availability of the entire didactic curriculum plus internet-based resources allows students to study and practice simulation independently of faculty and at their own pace. These capabilities foster student self-confidence and ease the transition to the clinical environment.

The Clinical Environment

Clinical work spaces are ergonomically designed and house digital units and comfortable, soft leather patient chairs. Dental units include mounted liquid crystal diode (LCD) plasma screens that can display electronic patient records. A specifically designed software program integrates digital radiographic data and patient data on the electronic patient record so the provider can view all of this information on the same screen simultaneously. With all patient data accessible, a comprehensive understanding of the patient is readily obtained. Effective time management and productivity are enhanced. Patients also can view their own oral images on the LCD, affording potential learning and motivational opportunities.

All operator consoles have 5 openings for plug and play instruments of the provider's choice and need. For every unit, one opening houses a triple syringe that is mounted on a side arm. Over 29 options are available for plugging into the other 4 openings; some examples are curing lights, trans-illuminating lights, piezo scalers, hand pieces, intra-oral cameras, and low speed and high speed hand pieces. The digitally run unit knows what instrument a provider is using once it is selected and activates it accordingly. The amount of water and speed used with a particular instrument can be digitally programmed as can the chair position.

Controlling for Disease Transmission

Several devices that are part of the UM technology are designed to reduce the potential for disease transmission. A comprehensive electronic patient record was an example previously mentioned; a "virtual keyboard" is another (Figure 7). Computer keyboards are notorious for harboring bacteria. A "virtual keyboard" essentially is a laser beamed hologram that can be projected onto any flat surface. Its light source emanates from a small projection device which is either directly connected to a PC via Universal Serial Bus (USB) or via wireless technology. The device also contains a small camera which uses optical recognition technology to allow the user to tap the images of the keys, complete with realistic tapping sounds, which then feeds into the laptop or PC. Students and faculty can "type" on the "virtual keyboard" and only the projection surface requires disinfection. This feature protects both patients and providers.
Software

Aside from the software system that integrates patient data, software is also needed to enhance students’ educational experiences. This system synchronizes curriculum content and applicable information into a student-friendly package, ie, one that is easily accessible, understandable, logically ordered, and useful. An application of this software might include a "library" that catalogues information on pathology. A student could then search for all information available on, for example, fibromas. With this software, available intranet sources, and internet Web sites would be pulled up and displayed. This information then could be used for patient treatment, a case study, or for board preparation.

Summary

When thought out and well-packaged, new technologies provide exciting learning opportunities for students and faculty alike. Although a challenging learning curve exists for all, effective training, a positive orientation spells success. Faculty mentors who share their personal experiences related to online and remote site teaching can be a valuable resource to other educators trying to incorporate innovative learning technologies. Successful teaching and learning strategies can then be incorporated into curricula, affording dental hygiene graduates the highest level of quality education.

Since the UMB curriculum transformation is new, outcomes data are not yet available. However, there is evidence that how students are taught influences their practice behaviors. With the increasing introduction of technology into dental hygiene employment environments, the millennial graduates’ exposure to advanced technology learning may help them transition from academics to the real world of dental hygiene practice. This paper has highlighted some of the benefits available in a learning environment geared to the student of the 21st century. Recognizing the needs of today’s student population and how individuals learn reinforces the importance and necessity for high technology offerings. The wave of the future is here and dental hygiene education will be on its crest.
References

Purpose. Military service members receive their dental care from military dental clinics. The purposes of this study were to assess satisfaction and to identify predictors of patient satisfaction with the hygiene provider in military dental treatment facilities.

Methods. Standardized surveys were administered from 2000 through 2004 by the Tri-Service Center for Oral Health Studies. Dependent variables were overall satisfaction with today's visit and overall satisfaction with the clinic's ability to take care of your needs. Independent variables were grouped by environment of care, beliefs about the care, and demographic characteristics. Principal component factor analysis and hierarchical multiple linear regression were used to test the hypotheses.

Results: A total of 98,792 surveys, with no missing data, from a sample of 130,801, were analyzed. Patients treated by hygiene providers were highly satisfied with dental care, as the mean score for satisfaction with today's visit was 6.61, and overall satisfaction with the clinic was 6.44 on a 7-point bipolar adjective rating scale. Factor analysis revealed that beliefs about care (46.7%) and environment (26.8%) were the most important factors to satisfaction. Both regression models developed for patient satisfaction achieved statistical significance. Model one, overall satisfaction with today's visit, obtained $R^2=.311$, with $F (6, 98785) = 8923$, $p<.0001$. Model two, overall satisfaction with the clinic, obtained $R^2=.284$ with $F (6, 98785) = 7848$, $p<.0001$.

Conclusions. This study demonstrated that beliefs about care are the most important factors associated with patient satisfaction with the hygiene provider. The interpersonal experience has a strong association with patients' assessment of care and thus, training providers about the relationship of satisfaction with the interpersonal experience can enhance overall satisfaction.

Keywords: satisfaction, patient satisfaction, dental hygiene, military, military dentistry

Introduction

Customer satisfaction with the hygiene provider appears to be lacking in the dental literature. An existing Department of Defense (DoD) patient satisfaction survey monitors the satisfaction of military beneficiaries who receive treatment in
military clinics throughout the world, but the data have never been analyzed in aggregate to identify trends or predictors of satisfaction. Patient satisfaction in military dental treatment facilities has not been formally assessed in over a decade. Additionally, previous assessments have focused on satisfaction with the overall dental experience, and not the hygiene provider.

Active duty service members of the U.S. Air Force, Army, Marines, and Navy receive the bulk of their dental treatment from one of 300 worldwide military dental treatment facilities. Clinics are located on ships, military bases, and in deployment environments. Dental hygiene services are provided by registered dental hygienists (RDHs) and prophy technicians in military dental clinics. The bulk of dental hygiene services are provided by RDHs who attended accredited US schools. RDHs who work for the military are required to maintain a current state license and follow the state's guidelines for continuing education requirements. The use and training of prophy technicians varies by each military service, but these providers are only authorized to remove supragingival calculus and are under direct supervision of other providers.

Review of the Literature

Traditionally, the clinician's technical competence and mechanical precision were important factors in the assessment of dental satisfaction; lay opinions played no role in this method of measuring quality. Consumerism forced dental professionals to compete for patients and traditional patient satisfaction became an important part of providing dental services.

A large body of work in the field of patient satisfaction exists in the medical literature. Medical care patient satisfaction studies have consistently shown that the quality of the interpersonal interactions between the provider and the patient play a large role in defining patient satisfaction. A similar body of research exists for the dental field. Ross and Duff found that patients return to the dentist for subsequent care due to satisfaction with the interpersonal component of the dental relationship rather than the technical quality of the care received. Evidence for both medical and dental patient satisfaction studies show that desirable interactions lead to more satisfied patients who better understand and more accurately follow prescribed regimens. A satisfied patient may have a different set of behaviors that ultimately manifest into both a healthier patient and a more satisfied customer. Newsome and Wright (1999) reviewed 46 studies of patient satisfaction and found the factors most commonly identified with dental patient satisfaction were technical competence, interpersonal factors, convenience, costs, and facilities.

Dental patient satisfaction among active duty service members has not been widely studied. Chisick conducted 2 studies of satisfaction on active duty military members. Similar to the civilian studies, Chisick focused on access, availability/convenience, interpersonal skills, and pain control as predictors of satisfaction. He concluded that active duty personnel were generally very satisfied with military dental care and satisfaction did not vary significantly across demographics. Access was a consistent predictor of decreased satisfaction levels.

Two recent studies have identified models to predict patient satisfaction with military medical care. Mangelsdorff and Finstuen identified that attitudes and beliefs about the care were the most salient factors in the prediction model. Waiting time, as a measure of access and age, health status, and gender demographic variables, were also significant predictors of satisfaction. A refinement of the model was recently published and validated the method. Military beneficiary status (active duty, retired, or family member), the reason for the visit, and variables regarding beliefs about the care and waiting time were added to the model and are predictive of patient satisfaction in the military setting. These previous studies are precursors to this project.

Dentists have become very aware that the interpersonal dynamics between the provider and the patient is an important determinant in perceived satisfaction. A study by O'Shea, Corah, and Ayer displayed that US dentists recognize that patient dissatisfaction has a significant impact on care-seeking behavior, and in particular, on decisions to seek a new dentist. With all the importance placed on dental satisfaction, there do not appear to be any published articles on consumer satisfaction with care given by the dental hygiene providers. Ovid lists 29 065 journal articles on patient satisfaction, 1386 articles on dental patient satisfaction, and 114 articles on dental hygiene patient satisfaction. The articles on dental hygiene
The purposes of this project were to identify levels and predictors of satisfaction with the hygiene provider in military dental treatment facilities.

Methods

This project is a secondary analysis of dental patient satisfaction data collected in military dental clinics. The data are anonymous and do not contain patient identifiers. The surveys are administered in the clinics with the use of the Random Appointment Time Slot Generator system, which generates the patients who are to receive the survey. All patients that seek treatment on the randomized day are asked to complete the survey.

Survey Instrument

The dental satisfaction survey was composed of 27 questions focusing on access, quality, interpersonal relationships, overall satisfaction, and demographic data, and was approved by the Department of Defense (DoD) Institutional Review Board to ensure patient privacy. The surveys analyzed for this project were administered from the fourth quarter of fiscal year 2000 through the fourth quarter of 2004. Seventeen digitized text files of data were received directly from the Tri-Service Center for Oral Health Studies, located in Bethesda, Md.

Data

The 17 text files were imported into SPSS v. 12 resulting in one master file with 658,443 cases. Respondents indicated whether they saw a dentist, dental hygienist, or both during their visit. Those who responded affirmative to receiving treatment only from a dental hygienist only during the visit were kept in the study, resulting in 130,801 surveys. Questions pertaining to satisfaction with the dentist were deleted. Subjects were only included in the final sample if all questions were answered, which resulted in a data set of 98,792 with no missing data.

Dependent Variables

The study examined 2 dependent variables. Y1 was defined as the assessment of satisfaction with the dental care for today’s visit and Y2 was defined as overall satisfaction with the clinic’s ability to take care of the patient’s dental needs. The 2 dependent variables were based on responses to a 7-point bipolar adjective rating scale as follows: Completely dissatisfied (1) Very dissatisfied (2) Somewhat dissatisfied (3) Neither satisfied nor dissatisfied (4) Somewhat satisfied (5) Very satisfied (6) or Completely satisfied (7).

Independent variables

The independent variables were divided into 3 major categories: demographics, beliefs about the care itself, and environmental factors. The demographic variables included on the survey were age, gender, beneficiary category (active duty, family member, or retiree), military rank, and military service. Patients responded to 7 belief questions regarding the care provided by the dentist and were rated on a 5-point scale as follows: Poor (1), Fair (2), Good (3), Very Good (4), Excellent (5). Environmental factors included whether the appointment was scheduled or not, number of days waiting for appointment, rating of the number of days waited for an appointment, whether the patient was seen on time for the appointment.
**Statistical Methods**

A principal component factor analysis with a Varimax rotation was used to assess the nature of dental satisfaction. The goal of this portion of the project was to identify the main components of satisfaction. Factor analyses allowed data reduction and increased the stability of the model. The variables identified in the factor analysis were included in the hierarchical multiple linear regression analysis to assess the predictive effects of the dependent variables on the satisfaction with today's visit. This methodology focused on the analyses of reduced and full regression models to estimate the individual and unique contribution of each independent variable. Hierarchical regression accounts for correlations among variables and allowed examination of each variable's effect on the model. Cronbach's alpha was used to assess inter-item reliability; alpha level was set at $p = .01$.

**Results**

Surveys with no missing data (n=98,792) from the last quarter of fiscal year 2000 through the fourth quarter of fiscal year 2004 were analyzed for this portion of the project. The surveys analyzed for this project constitute 75.5% of all returned questionnaires that indicated the visit was for dental hygiene care only. The majority of subjects were male (76.6%, n=75,700) and reported being an active duty service member (98.6%, n=97,370). The service affiliations of respondents were as follows: Air Force - 31.3% (n = 30,945), Army - 29.2% (n = 28,891), Marines - 14.0% (n = 13,826), Navy - 24.7%. The majority of active duty respondents were enlisted personnel (81.2%, n=80,142) with the remaining subjects being officers.

Descriptive statistics, including means and correlations, for the independent and dependent variables are presented in Table 1. Overall satisfaction was rated high, as the mean score for overall satisfaction with today's visit was 6.61 (SD .79), and overall satisfaction with the clinic's ability take care of the needs was rated 6.44 (SD .82) on the 7-point bipolar adjective rating scale. Among the respondents, 97.5% noted that they would return to the clinic for care if they were given that choice. The ratings of the beliefs about care were high as well. The courtesy and friendliness of the dental hygiene provider was rated highest, receiving a mean score of 4.79 and thoroughness of the dental hygiene treatment received a mean score of 4.73 which was the lowest rating of the 3 beliefs about care ratings. Satisfaction for the 2 dependent variables, satisfaction with today's visit ($Y_1$) and overall satisfaction with the clinic ($Y_2$) are presented for each of the demographic variables; differences in satisfaction are minor across the demographic variables presented. Older individuals and those who had scheduled appointments have higher levels of satisfaction. The longer wait times associated with 'walk-in' patients may describe lower levels of satisfaction for those patients with no appointment.
The principal component factor analyses with Varimax rotation identified 2 major components of patient satisfaction and are presented in Table II. The 3 variables associated with rating beliefs about the dental hygienist were significant, and included in the beliefs factor, and allow us to rank the importance of these beliefs. The first construct identified was termed beliefs about care and all 3 variables associated with rating satisfaction with the hygienist were significant and included in the beliefs factor. The rotated factor loadings (correlations) for each of the 7 dentist satisfaction questions were as follows: overall quality of care (.956), thoroughness of treatment (.945), and dental hygienist courtesy and friendliness (.932).
The second factor identified was termed the environment factor and it was composed of 3 variables. The rotated factor loadings for each of the 4 environmental variables were as follows: number of days patient waited for appointment (.875), scheduled appointment (.658), and a rating of number of days patient waited for appointment (-.658). Beliefs about the care accounted for 46.76% and environmental factors 26.78% of the total variance. Cumulatively, the 2 factors accounted for 73.54% of the total variance in dental satisfaction.

Hierarchical multiple regression models were created for each of the 2 dependent variables using the variables identified by factor analysis. Table III presents the results of the regression model of the dependent variable overall satisfaction with dental care received during today's visit ($Y_1$). All tested effects, except scheduled appointment, are significant at the alpha equals .01 level. The full regression model accounts for 31.1% of the shared variance, with $F (6, 98785) = 8923, p <.0001$. The hierarchical regression allowed the identification of the largest contributors to the full model. Beliefs about the care is an aggregation of all three questions regarding care received by the hygienist and account for 24.4% of the total variance with a $F$ statistic $(3, 98785) = 11,681, p <.0001$. The belief factor accounts for almost 78% percent of the 31.1% of the shared variance. Held in isolation, each individual belief does not describe a large percentage of the variation. Cronbach's alpha was .944, which suggests high inter-item reliability of the 3 questions, which may explain why the aggregate beliefs variable accounted for large proportions of the shared variance versus each individual effect tested. The environmental factor and 3 variables that comprise the factor were all statistically significant but only describe 1.1% of the shared variation. Though these areas may be important to practice management, they do not seem to play a large role in patient satisfaction with the hygiene provider.
The second regression model utilized overall satisfaction with the clinic's ability to take care of the dental needs as the dependent variable. The full model $F(6, 98785) = 7,848.7, p < .0001$ accounts for 28.4% of the shared variance. Similar to the first model, beliefs about the care itself $F(3, 98785) = 6,256.1, p < .0001$ is the single largest predictor of satisfaction, accounting for 13.6% of the shared variance. Environmental factors $F(3, 98785) = 3343.2, p < .0001$ accounted for 7.2% of the shared variance. Of the environmental factors, the rating of days waited for the appointment seemed to be the most salient factor, accounting for 6.5% of the shared variance and reported in Table IV. Respondents rated waiting time as more important for the overall assessment of the clinic versus the assessment of today's satisfaction.

### Table III. Hierarchical Multiple Regression Analyses of Hypotheses associated with $Y_1$

<table>
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<tr>
<th>Effects tested</th>
<th>$R^2$ Full</th>
<th>$R^2$ Reduced</th>
<th>$R^2$ Change</th>
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<th>$d_2$</th>
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<td><strong>Full Model Regression</strong></td>
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Note: $N = 98,792$ hygiene patients

### Table IV. Hierarchical Multiple Regression Analyses of Hypotheses associated with $Y_2$

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<th>Effects tested</th>
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<th>$R^2$ Reduced</th>
<th>$R^2$ Change</th>
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Note: $N = 98,792$ hygiene patients
Discussion

This study is seminal in nature as it is the first in the literature to assess levels of dental satisfaction with the dental hygiene provider. While there are many articles in the literature on dental hygienist job satisfaction, education satisfaction, and satisfaction with procedures or adjunctive devices, there appears to be a vacuum of evidence for patient satisfaction with the dental hygienist. The results clearly indicate that military members are highly satisfied with the hygiene care they receive at military dental clinics. Though no direct comparisons of the findings are possible due to a lack of literature, the findings are consistent with the limited literature on military dental satisfaction. The regression models strongly suggest that patient beliefs about received care are the primary drivers of patient satisfaction. Patients do not typically have the ability to assess the technical competence of providers and thus use the interpersonal exchanges as a surrogate for technical competence. Patients' perceptions of the appointing process are also important to satisfaction. Respondents indicated that the "rating of the number of days waited for an appointment" was more important than the actual "number of days waited," suggesting that individuals do not always equate waiting for an appointment as negative, but rather base their decision on other factors as well. These findings suggest that providers and administrators cannot focus on one aspect of the appointing process as patients tend to rate these areas in aggregate.

It may be of interest to note that none of the demographic variables achieved significance and were therefore excluded from the models. The military has a highly diverse population and there were no practical satisfaction differences based on the available demographic information. Race, educational level, and income were not captured in this survey, but the rank structure and income potential serve as a surrogate for education.

The methodology utilized increased validity as the researchers were not forced to make assumptions about the missing data. Reliability of the study is enhanced by analyzing 17 fiscal quarters of data. This is an extremely large sample and thus statistical significance can be based solely on sample size and caution must be exercised to determine statistical versus clinical/practical significance. The results of this study do have some limitations as to the generalizability. A major limitation is that this survey assessed satisfaction of dental clinic users as opposed to all eligible beneficiaries. This effect may be mitigated by policy requiring all military members to have yearly dental examinations. Representativeness of respondents is a concern as the DoD reported that the active military force was comprised of 83.1% enlisted in September of 2004. Of the 1,426,836 service members, 35% were Army, 27% Air Force, 26% Navy, and 12% Marine Corps. This would indicate that the surveys are representative of the enlisted-officer ratio that comprises the military, but the Army and Navy are underrepresented, while the Air Force is over-represented. Additionally, limitations include excluding almost 25% of the cases due to missing data, but further analysis showed that all 3 measures of satisfaction with the hygiene provider are .04 higher, on a 5-point scale, as compared to excluded cases. The ANOVA results for all 3 belief-related questions does indicate that there are statistically significant differences between the groups, but this is due to the extremely large sample size. Even though statistically there are differences between the 2 samples, practically there are not differences.

Hygiene practice in the military does have some distinct differences as compared to the civilian sector. Military dental clinics in the United States only provide dental services to service members, and thus family members seek their dental care in the private sector. Due to the frequent moves and mobilizations of service members, there is a lack of empanelment of patients to one particular provider. Thus, service members often receive their hygiene care from a different provider at each appointment. Private sector insurance authorizes 2 prophylaxes annually, whereas most service members receive only one prophylaxis annually. These issues provide some unique challenges to providing dental hygiene care in the military setting.

Conclusion

This study has demonstrated that patient beliefs about the care received from the dental hygienist are the largest single predictor of patient satisfaction. These findings have important implications for military and civilian dental hygiene providers. The findings validate the importance of patients' perceptions about care versus the professions trend to base quality care on the technical assessment of care. This suggests opportunities for potential behavior modification in the patient encounter. The mere knowledge of these attributes is essential to improve the patient-provider interaction. For institutional settings, a training vehicle could be developed to make providers aware of the importance of patient beliefs
about the care and methods of how the hygienist can use this information to provide patients with increased satisfaction with their dental encounters.

Acknowledgements

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Notes

Correspondence to: LTC Jeffrey Chaffin at jeffrey.chaffin@us.army.mil.

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Musculoskeletal disorders of the neck and shoulder in dental hygienists and dental hygiene students

Tim Morse, PhD, CPE, Heather Bruneau, MPH, Claudia Michalak-Turcotte, CDA, RDH, MS, Martha Sanders, MA, OTR/L, Nicholas Warren, ScD, MAT, Jeff Dussetschleger, DMD, Ulysses Diva, MS, Marc Croteau, MD, MPH and Martin Cherniack, MD, MPH

Tim Morse, PhD, CPE is an associate professor and ergonomist in the Department of Community Medicine and Ergonomic Technology Center (ErgoCenter). Heather Bruneau, MPH, is a former graduate assistant with the ErgoCenter and is currently a medical student at UConn Health Center. Nicholas Warren, ScD is an assistant professor and ergonomist in the ErgoCenter. Jeff Dussetschleger is a dentist and graduate assistant in the Master of Public Health Program and ErgoCenter. Marc Croteau, MD, MPH is an assistant professor in the Division of Occupational and Environmental Medicine. Martin Cherniack is professor and clinical director for the ErgoCenter. All are with the University of Connecticut Health Center in Farmington, CT. Ulysses Diva, MS is a doctoral student in the Statistics Department at the University of Connecticut in Storrs, CT, and a graduate assistant in the ErgoCenter. Claudia Michalak-Turcotte, CDA, RDH, MS, is an associate professor in the Department of Allied Dental-Dental Hygiene at Tunxis Community-Technical College and University of Connecticut Health Center in Farmington, CT. Martha Sanders, MA, OTR/L, is an assistant professor of occupational therapy at Quinnipiac College in Hamden, CT.

Purpose. Dental hygienists have been found to have high rates of neck and shoulder disorders, but there is very limited information on risk factors associated with those disorders, the level of risk for students, and the relationship of prior work as dental assistants for dental hygiene students. This study examines self-reported and physician-diagnosed neck and shoulder pain.

Methods. A cohort consisting of 27 dental hygiene students with no prior dental occupation experience (mean age 24, 6.2 SD), and 39 dental hygiene students with prior experience as dental assistants (mean age 28, 6.0) and 94 experienced dental hygienists (mean age 46, 8.8) completed a questionnaire on risk factors and self reported pain, and were examined by a physician in reference to upper extremity findings and diagnoses. Analysis included tabular, trend, and logistic regression analysis.

Results. There were significant differences for risks, symptoms, and physician findings. Risk factors had a stepwise progression for students, student/assistants, and experienced dental hygienists, including working with a bent neck often or very often (79%, 89%, 96%, respectively, p<.001), static posture (39%, 50%, 63%, p<.001), precise motions (58%, 67%, 90%, p<.001), and repetition (79%, 86%, 98%, p<.001). Neck symptoms were reported by 37%, 43%, and 72%, respectively (p<.001), and 11%, 20%, and 35% for shoulder symptoms (p<.05). Similar patterns were demonstrated in physician findings, particularly for neck disorders (18%, 36%, 50%, p<.01). In regressions, self-reported shoulder pain was significantly associated with working above shoulder height (OR=1.5, CI 1.0-2.4), and neck symptoms with working with a bent neck (OR=2.1, CI 1.3-3.4), with a protective effect from high supervisor support (OR=0.5, CI 0.2-1.0).

Conclusion. Risk factors and both self-reported and physician-diagnosed neck and shoulder symptoms increase in frequency from students to experienced hygienists, and students have higher prevalence if they are also dental assistants.
Keywords: Ergonomics, cumulative trauma disorders, musculoskeletal disorders, dental hygienists, dental assistants, risk factors, neck and shoulder disorders

Introduction

High rates of occurrence of upper extremity musculoskeletal disorders (MSDs) in dental professionals (dentist, dental hygienist, and dental assistant) are well documented, including regional neck and shoulder pain, shoulder tendonitis, neuropathy, tension neck syndrome, and trapezius myalgia,\textsuperscript{1-15} with more recent attention given to students either as a control group or as a newly exposed group.\textsuperscript{11,16} Much of the focus has centered on dentists and dental hygienists, while fewer studies attempt to estimate the prevalence of MSDs among dental assistants and dental hygiene students. The few studies that have examined MSD prevalence in dental assistants and dental hygiene students have found mixed evidence for appearance of early symptoms.\textsuperscript{11,17-19}

It is likely that specific MSDs, such as those localized to the shoulder, elbow, and neck, have different risk factors.\textsuperscript{2} Furthermore, different types of occupations, even within the same occupational category (dentists, dental hygienists, assistants all fall under the dental professional category), may be at risk for different types of cumulative trauma disorders of the upper extremities (CTDUE).\textsuperscript{2}

This report characterizes neck and shoulder conditions for a sample of 94 experienced dental hygienists, 27 dental hygiene students, and 39 dental hygiene students who are also dental assistants, utilizing both survey and physician physical exam, and evaluates associations with self-reported risk factors.

Literature Review

Historically, researchers have focused on the overall prevalence of musculoskeletal disorder (MSD) in dental professionals. The reported prevalence of general MSD pain and neuropathy in dental hygienists ranges from 60% to 96%,\textsuperscript{2,20} depending on the specific population studied and the research measures employed. The 96% prevalence was from a mailed survey in Kentucky to 433 licensed dental hygienists (n=245 responses) utilizing a body diagram, with the neck, shoulder, and back as the most frequent symptom locations.\textsuperscript{20} A written questionnaire completed by all 109 attendees at a dental hygiene continuing education conference found 93% reporting at least one job-related ache, pain, or discomfort in the previous 12 months.\textsuperscript{6} Approximately 60% of 260 practicing hygienists (56% response rate) reported symptoms related to upper extremity neuropathy (self-reported "altered sensations," with the most common being pain, tingling, and numbness) based on a survey of licensed dental hygienists in Nebraska; sixteen percent indicated they had been medically diagnosed with an upper extremity neuropathy.\textsuperscript{21}

Fewer studies have examined the prevalence of MSDs in specific body regions and the specific risk factors (biomechanical and psychosocial) associated with pain in these regions. The neck/shoulder region has been reported as of concern but not studied in depth. Werner et al found that 13% of a sample of 305 dental hygienists had shoulder tendonitis based on a physical examination.\textsuperscript{22} Al-Wassan et al found that 54.4% of a sample of 204 dental professionals (85% response rate) in 5 dental offices in Saudi Arabia (dentists and dental professionals, including 12 dental hygienists) experienced neck pain, although the frequency of neck pain was significantly higher (p=.01) in dentists than other dental professionals.\textsuperscript{15} Szeluga found subjective neck pain prevalence rates as high as 82% (75.9% for shoulder) in a mailed survey of 433 dental hygienists in Kentucky, although only 5.4% reported missing work because of the pain.\textsuperscript{20} Akesson reports that 81% of a sample of 30 dental hygienists had specific neck/shoulder findings on physical examination, and 43% were diagnosed with specific neck/shoulder MSDs, including tension neck syndrome and trapezius myalgia.\textsuperscript{1} Yee found 75% of 529 dental hygienist respondents (37% response rate) reporting neck discomfort over the prior 12 months, and 61% reporting shoulder discomfort...
in a mailed survey of licensed hygienists in 2 California counties. Clearly, wide disparities exist in the measuring and reporting of neck pain, as well as other MSDs, among dental hygienists.

**Musculoskeletal Disorders in Dental Assistants and Dental Hygiene Student**

The prevalence data on MSDs in students is sparse in comparison to prevalence data for dental hygienists. A prospective cohort study conducted by Akesson et al in female dental personnel found that 65% of dental assistants reported overall MSD pain; thirty-five percent of those fit the clinical criteria for specific MSD diagnoses, and 42% of the cohort reported subjective pain. The same study reported a Tension Neck Syndrome (TNS) prevalence of 21.4% in dental assistants. Although dental hygiene students generally have less cumulative duration of exposures, they gradually increase their exposures throughout their clinical training, and some studies found a corresponding increase in symptom prevalence. Morse et al, in the pilot phase for this study, found 46% of dental hygiene students reporting upper extremity pain, with increasing symptoms in later years of training. Barry et al noted an increase in musculoskeletal pain and an increase in non-neutral posture for 9 students over the course of dental hygiene education, extending into the first 2 practicing years. In a 3-year study following dental hygiene students through their clinical education and the start of their career, Conrad et al found no change in median nerve velocity but a shift in vibrotactile thresholds characteristic of injury to fingertip nerve receptors. However, Werner et al reported relatively low levels of MSD in dental hygiene students (16% neck and shoulder symptoms for a combined sample of dental and dental hygiene students), and no differences by year in school.

**Risk Factors**

The diagnoses and risk factors related to shoulder and neck MSDs are often separated into 2 groups: one involving problems confined to the shoulder joint area and the other involving problems confined to the upper shoulder and neck area. The first group, including such diagnoses as rotator cuff syndrome, has been well documented in the literature as being associated with dynamic work with heavy loads. Problems of the upper shoulder and neck are thought to be associated with repeated or sustained exertion in awkward or static postures, even with low external loads. Diagnoses such as tension neck syndrome (TNS), involving painful neck spasms and trigger points, have also been associated with this type of loading pattern, which is common in dental hygiene work. Sanders and Michalak-Turcotte have noted that dental hygienists frequently work with neck flexion over 30 degrees, with side bending or rotating, and shoulder abduction over 45 degrees. In an observational study of 10 dentists and 10 dental hygienists, Marklin and Cherney found that hygienists flexed their necks at least 30 degrees 86% of the time, with shoulders abducted (elevated to the side of the trunk) at least 30 degrees for 45% and 34% of the time (left and right side, respectively). These postures may be combined with high static loads and fatigue in the trapezius muscles. In addition, there may also be relationships to personal characteristics (such as height), high visual demands, workplace organizational and psycho-social factors, and lack of recovery time. Smith et al note that dental hygiene tasks are similar to dental tasks, where high levels of flexion and rotation of the neck have also been observed. Barry suggests in a small longitudinal study that there may be a change to forward-leaning posture when dental hygienists move into the working environment, which may contribute to an increase in neck and shoulder pain. Yee et al suggest that amount of usage is more important than workstation design, since they found that handedness was a clear determinant of whether dental hygienists had left sided or right sided pain. Bramson et al found in a videotape ergonomic analysis of 15 dental hygienists that shoulder risks averaged 4 on a 7-point scale (based on a combination of postures, force, frequency, duration, past injuries, and present discomfort), and neck risks averaged the maximum of 7.

In summary, no studies have focused specifically on neck or shoulder disorders in dental hygienists or dental assistants, and detailed studies have had very small sample sizes, resulting in an inability to test for differences in prevalence rates between groups and to discover associations with specific risk factors. This study combines both a large sample size with questionnaire and detailed physician assessment, providing the first opportunity to confirm suggestions raised by previous
studies and test for differences. The aim of the present study was to (1) test for differences in prevalence of both subjective and objective neck symptoms (including pain, aching, burning, numbness and tingling, and spasm) between dental hygienists, dental assistants and dental hygiene students; (2) to test if higher (longer) exposures result in higher prevalence (ie, between students and experienced hygienists); and (3) to identify risk factors significantly associated with neck MSDs in dental professions and clinical training in order to better target preventive measures.

Materials and Methods

The dental hygienists (DH) and dental hygiene students (DS) were part of an international, longitudinal multi-cohort study (the HAVIC, or Hand-Arm Vibration International Consortium study) funded by NIOSH, specifically focused on the effects of vibration on the development of MSDs. The study and all associated tests were approved for human subjects by the University of Connecticut Health Center Institutional Review Board (Study #01-093). Dental hygienists and dental hygiene students comprised 2 of the 5 cohorts examined; other groups included auto assembly line workers, forestry workers, and shipyard employees. Practicing hygienists were required to have at least 5 years experience and could not be retired. Based on preliminary prediction of a 20% response rate and a target of 80 subjects, 400 individuals were randomly selected from a licensure list from the local area and contacted by mail and phone. The recruitment goal was exceeded, thus the excess of participants. In all, 92 women and 2 men consented to participate (24% response rate). Dental hygiene students were orally recruited by faculty at each of the 3 dental hygiene schools in Connecticut. Participants were asked to volunteer for an approximate 3-4 hour set of medical procedures and a questionnaire, and were offered a modest honorarium of $50 ($100 for those driving a long distance) for participation. After obtaining informed consent, participants completed a 40-page questionnaire and an extensive upper extremity physical examination. A battery of diagnostic tests were also performed but are not included in this report, including surface nerve conduction, tactometry, and plethysmography.

Questionnaire Instrument

The full questionnaire contained questions representing each of the following content areas:

- A full occupational history for the previous 10 working years.
- Duration of time spent in specific tasks related to biomechanically related postures and risk factors, including force, repetition, static posture, and awkward postures, such as bent and twisted neck.
- The Job Content Questionnaire (JCQ), an assessment of psychosocial risk factors for MSDs, including job control, job demands, and social support.
- Specific questions detailing the type, location, and severity of symptoms of pain, paresthesia, or whiteness in hands or fingers, and pain, paresthesia, limited movements, or spasm in shoulders, elbows, neck, forearms, and lower back.

The self-administered questionnaire had student and practicing hygienist versions, with questions adapted as necessary for the 2 backgrounds. There were detailed questions concerning both student and job history in relation to years, exposures, level, type, and amount of time in clinical practice or training, etc. Questionnaires were individually reviewed for completeness and consistency by study managers upon completion, with missing data and inconsistencies corrected by the participant before departure from the study location. All questions for practicing dental hygienists were in reference to their jobs. Dental students were asked about their year in school, clinical experience as part of school, dental job experience outside of school, and other current jobs outside of school. Students were instructed to answer exposure questions (such as use of scaling instruments, bent necks, etc.) in relation to current dental jobs and/or clinical experience as part of clinical training. First-year students with no clinical exposures responded as zero exposure to the dental instrument use questions; for job stress-related questions they responded in relation to either other jobs or student status if there was no outside job. Exposure-specific questions were developed to profile each work environment. These were originally profiled by 2 members of the study team experienced in dental hygiene (C M-T, M A-S), revised in numerous focus groups, distributed in an exploratory questionnaire, and refined for the final version. Particular attention was paid to historical variability in work schedules, equipment and procedural changes, and multi-site employment. Mannequin type drawings for purposes of symptom localization were used, with emphasis on each upper extremity region with symptom specific
dermatomes, in order to better define self-reported CTS related symptoms. The musculoskeletal symptom questionnaire was formulated from multiple sources, in particular from the Connecticut Upper Extremity Surveillance Project (CUSP), a population-based random phone survey of 3200 Connecticut workers, which in turn was taken largely from previously validated instruments including the US Department of Health 1988 National Health Interview Survey (NHIS), the Occupational Safety and Health Administration (OSHA) Draft Checklist, the Dutch Monitor Survey, and the Standardized Nordic Questionnaire. We included sections of the validated Levine Functional Status and Symptom Severity Scales. The JCQ is composed of 33 questions that address job demands, job control, and social support. Supervisor support, for example, is composed of the sum of responses to 5 questions on a 4-point Likert scale: (1) My supervisor is concerned about the welfare of those under him/her; (2) My supervisor pays attention to what I am saying; (3) I am exposed to hostility or conflict from my supervisor (reverse coded); (4) My supervisor is helpful in getting the job done; and (5) My supervisor is successful in getting people to work together.

Perceived biomechanical risk factors were evaluated utilizing a 4-point Likert scale consisting of never, seldom, often, and very often. Respondents were asked "Does an average working day in your current job involve any of the following conditions?" for the following:

(1) Is the neck repeatedly or for long periods (a) bent forwards, backwards or sideways, (b) twisted, (c) bent and twisted simultaneously;

(2) Is prolonged or recurrent work performed with the arms stretched forwards or outwards, unsupported, or above shoulder height;

(3) Is work repeatedly done with the forearms and hands with (a) twisting movements, (b) forceful movements, (c) uncomfortable hand positions/grips, (d) heavy demands on precision; and

(4) Is prolonged or recurrent work done with repeated similar working movements?

Physical Examination

The physical examination was a 30-minute intensive upper extremity evaluation performed by a physician specifically trained in assessing musculoskeletal symptomatology, with a written protocol and decision guide, with a video made of the exam to assure consistency. The physical examination had 4 stated purposes: elicitation of clinical signs, the assessment of neuromuscular, vascular and musculoskeletal function, the recognition of possible signs of Hand-Arm Vibration Syndrome (HAVS), and the developmental of differential diagnoses based on clinical findings. A standardized upper extremity clinical instrument was developed, incorporating proximal and distal evaluation. It included a structured clinical examination involving 32 muscle groups, and an integrated assessment of function within anatomic zones, and assessments of mobility, motion derived discomfort, and postural integrity. Elicitation of more than 20 recognized clinical signs are included, such as the Adson's test, Roos test, Allen's test, Wright's test, Tinel's sign, Phalen's test, and Finkelstein's test. Each clinical test and detailed procedure was reviewed for consistency with other standardized examinations. The training of physician examiners across multiple international sites was accomplished through a video-taped instructional examination coupled to a written script.

This paper will focus on shoulder and neck diagnoses and findings, including impingement syndrome, rotator cuff tendonitis, range of motion abnormalities, scapular winging, superior trapezius pain and trigger points, and findings for the Adson's, Roos, and Spurling tests.

The muscles of the rotator cuff function to stabilize the shoulder, rotate the shoulder, and abduct the shoulder beyond 20 degrees. Inflammation or a tear at this site may lead to weakness and pain in the shoulder, typically exacerbated by shoulder joint movement such as reaching. Causes of rotator cuff tendonitis include hard and/or repetitive movement of the shoulder. Shoulder impingement implies a loss in range of motion, with risk factors including poor muscle conditioning, flexed forward postures, and overhead work. Pain with resisted shoulder abduction or resisted external rotation is characteristically elicited with rotator cuff tendonitis and not with impingement syndrome.
Thoracic outlet syndrome is caused by the compression of the brachial plexus and/or subclavian artery. This results in pain and abnormal nerve sensations in the neck, shoulder, arm, and/or hand. This condition can be seen in workers with abnormal postures, such as performing extensive overhead work or computer workers with weak proximal musculature. Abnormal provocative physical exam maneuvers such as a Roos test or an Adson's test are consistent with thoracic outlet syndrome.45,46

Neck pain is a nonspecific finding. It is often due to muscle spasm of the neck muscles or trapezius muscles, although multiple other causes exist. A Spurling test is a physical exam maneuver that compresses the neck in order to evaluate the possibility of nerve root involvement.45

Data Analysis

All statistics were generated using SPSS version 10.1 for Windows. Tabular analysis was used for symptoms reports, diagnoses, and biomechanical factors. Chi-squares were calculated, using 95% confidence levels (2-tailed). Trend analysis across the 3 occupational groupings was calculated using Gamma coefficients where there was sufficient sample size in the observed categories. Confidence intervals and gamma values were calculated for physician diagnosis percentages to account for sample size. Bivariate analysis was utilized to define zero order correlations. Multivariate analysis (binary logistic regression) was performed on all 29 independent variables (occupation, demographics including age, height and weight, biomechanical, and psychosocial variables) by determining statistically significant (using p<.10 for inclusion in the equation to allow for keeping in variables of interest for final models) variables using forward conditional analysis. Those variables (including age in all models) were then used in an enter method binary logistic regression, with age included in all models. Groups (ie, occupation) were added into the model as dummy variables. Final models using only significantly associated variables (at p<.05 level) were run to minimize missing values.

Results

Participants

Ninety-four (94) experienced (minimum of 5 years in the field) Connecticut dental hygienists and 66 dental hygiene students from the 3 accredited Connecticut dental hygiene schools participated in the study. The overall response rate for the experienced hygienist mailings was 23.5% (94 participants out of approximately 400 valid initial mailings). The overall response rate for the dental hygiene students was 46% based on the approximately 145 eligible students.

For analytic purposes, the 66 dental hygiene students were split into 2 groups: 27 whose exposures were based on current education only (dental hygiene students, S) and 39 who also had exposures from present or previous work as a dental assistant in addition to exposures during dental hygiene education (SDA). Of the dental hygiene students, 45% (n=29) were first-year students, with the rest second-year or third-year students.

Experienced hygienists were significantly older, had more years in the field, worked more hours per week, saw more patients per day, and had more usage of both manual and vibrating instruments (Table 1). Dental hygiene students who were also assistants had averages between those of nonassistant students and experienced hygienists.
Risk Factors Reported by Hygienists

Respondents reported on their perceptions of the frequency of biomechanical risk factors that have been classically considered in relation to upper-extremity MSD, including bent and/or twisted neck, static posture (holding the same position, un-supported), hand/arm repetition, twisting the hands or wrists, using forceful hand motion, precise hand work, and holding the hands above shoulder height (see Methods for question wording). Figures 1 and 2 present the proportion of respondents who responded with "often" or "very often," categorized by dental hygiene students (S), dental hygiene students who also work as dental assistants (SDA), and experienced dental hygienists (DH).
The distributions of most exposures exhibit statistically significant differences (see chi-square and corresponding p-values in Table 2) between the 3 groups. These include working with a twisted neck, bent neck, static posture of the arms, twisted arms, using precise motion, and repetition ("repeated similar working movements"). Forceful motion of the arms and
working with arms above shoulder height were not significantly different. Differences were typically even more pronounced for the most extreme (“very often”) category (Figures 1 and 2).

**Table II: Significance statistics for risk factors (very often and often vs. never and seldom), comparing students, students/assistants, and experienced hygienists**

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<tr>
<td>Neck bent</td>
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<tr>
<td>Static posture</td>
<td>24.0**</td>
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<tr>
<td>Repetition</td>
<td>31.6**</td>
<td>.7**</td>
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<tr>
<td>Twisted hands</td>
<td>16.3*</td>
<td>.4**</td>
</tr>
<tr>
<td>Forceful motion</td>
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<td>.2</td>
</tr>
<tr>
<td>Precision</td>
<td>28.8**</td>
<td>.6**</td>
</tr>
<tr>
<td>Above shoulder</td>
<td>3.9</td>
<td>.3</td>
</tr>
</tbody>
</table>

* = p < .01; ** = p < .001

Most of the risk factors showed a clear stepwise increase from dental hygiene students, students who were also dental assistants, and experienced dental hygienists. The gamma coefficients in Table II indicate statistically significant increasing trends in the exposure severity as we progress from dental hygiene students to dental hygienists. The interpretation of gamma is similar to that of correlation coefficients such as Kendall's tau, with 1.0 indicating perfect agreement; the statistically significant coefficients illustrate moderate to strong relationships, with gammas ranging from .4 (twisting hands) to .8 (twisted neck). Coefficients for forceful motion of the arms and working with arms above shoulder height were not significantly different, consistent with the chi-square tests results. On the other hand, even if there were differences in the distribution between groups for static posture, the differences were not consistent with an increasing trend.

Self-Reported Neck Symptoms

Point prevalence rates for subjective neck symptoms (defined as pain, aching, stiffness, spasm, inability to move head, burning, numbness, or tingling) were significantly different between the experienced hygienists and the 2 student groups (chi-square=14.9, p<.001), with hygiene students reporting 37.0%, assistants 43.2%, and experienced hygienists 72.3% (Figure 3). In addition to the increases in percentage of participants with reported pain from student to dental assistant/student to experienced hygienist, there was also an increase in the percentage that reported pain either daily or constantly (Figure 3).
Of those reporting pain, students and assistants both reported a median of 3.0 years of duration of the pain, with 9.5 years for experienced hygienists (F=10.4, p<.001). The mean neck pain for those reporting pain was not significantly different between groups, with 3.7 for students, 3.8 for assistants, and 3.2 for experienced hygienists (on a scale of 1-10, with 10 as worst pain). Of those reporting pain, 30% of students reported the neck pain traveled to the shoulder, compared to 60% for assistants and 67.6% for experienced; however, these differences were not statistically significant (chi-square=5.3, N.S.). Similarly, none of the students reported the pain traveling down to their arms, compared to 18.8% of assistants and 24.2% of experienced hygienists; these differences also were not statistically significant (chi-square=3.2, N.S.).

**Self-Reported Shoulder Pain**

Shoulder pain in the last 12 months was reported by 26.9% of respondents overall. This was also significantly different for the 3 groups (Pearson chi-square=8.2, p=0.016), with 11.1% for students, 17.9% for students/assistants, and 35.1% for experienced hygienists. Symptom frequency was increased monotonically across groups for daily/constant, increasing from 0% for students to 5% for student/assistants, to 15% for experienced.

Of those reporting shoulder pain, students reported a median of 5.0 years of duration of the pain, with nonsignificant differences of 2.5 years for student/assistants, and 5.0 years for experienced hygienists (F=1.7, N.S.). The mean intensity of pain (prior 7 days) for those reporting pain was 0.0 for students, 1.8 for student/assistants, and 3.4 for experienced hygienists (on a scale of 1-10, with 10 as worst pain; F=4.3, p=0.021).

**Regression on Self-Reported Neck Pain**

There was an odds ratio of 3.5 (95% CI 1.8-6.9) for experienced dental hygienists compared to all students (including dental assistants) for self-reported neck pain on the initial bivariate logistic regression (-2 log likelihood=200.8; Nagelkerke r2=.11). The odds ratio increased somewhat (OR= 5.0, CI=1.7-15.0) by controlling for age, even though age was not significantly associated with neck pain in the regression. This odds ratio for neck pain among experienced dental hygienists decreased to a below significance 2.0 (N.S.) when “working with a bent neck” (OR=2.1, CI 1.3-3.4) and supervisor support (OR=0.47, CI 0.22-1.0) are entered into the equation. These findings suggest that the differences found between the students
and the experienced dental hygienists may be explained by working with the neck flexed, with a protective effect from good supervisor support.

The number of hours of cleaning teeth was significantly related to neck pain when entered in an equation by itself (OR=2.1, CI=1.2-3.9); however, this lost significance when entered into the equation with the student/experienced variable.

None of the other biomechanical or psycho-social questions or factors achieved statistical significance in relation to self-reported neck pain.

Regression on Self-Reported Shoulder Pain

There was an odds ratio of 2.7 (95% CI 1.2-5.9) for experienced hygienists compared to all students (including dental assistants) for self-reported shoulder pain on the initial bivariate logistic regression (-2 log likelihood=181.3; Nagelkerke $r^2=.06$). Age was not significantly associated with shoulder pain, and did not appreciably change the odds ratio for the cohort. When entered in a separate model, holding arms above shoulder height was significantly related to shoulder pain (OR=1.5, CI=1.0-2.4), but this dropped below significance when combined with the student/experienced variable, and reducing the cohort odds ratio slightly to 2.3. One dental task, the amount of polishing teeth, was significantly related to shoulder pain (OR=2.5, CI=1.4-4.5); this stayed significant even when student/experienced was entered in the equation.

**Physician Diagnoses**

Physician diagnosed neck and shoulder findings, based upon the standardized physical exam, are reported below. Table III presents specific neck and shoulder exam findings by the percentage in each cohort, 95% confidence intervals, and gamma estimates for trends across the 3 subgroups.
There were not significant trends for shoulder findings across the 3 groups (Table III). In an epidemiological study of this occupation, scapular winging may be more a function of thin stature associated with younger age than a condition with medical significance, although it is taken into consideration clinically in someone with symptoms. As a result, overall findings are shown both including and excluding winging. Prevalence rates of rotator cuff tendonitis and limitations in shoulder abduction and shoulder flexion were low in all 3 groups.

Two specific neck findings (superior trapezius pain and trigger points) had significant moderately increasing trends, as did the combined category of “any neck findings” (Table III). The overall neck findings association (gamma=0.424, p<.01) is driven primarily by the superior trapezius findings. There were not significant trends in relation to either the Roos or Adson's tests. There was a significant trend for overall neck and shoulder findings only when the scapular winging finding was excluded.

There is a high level of agreement between self-reported neck symptoms and the physician-diagnosed findings. Eighty-three percent (83%) of subjects who reported no symptoms also had normal exams, and 57% of subjects who reported symptoms also had physical exam abnormalities (Kappa=0.37, p<.001).

However, the concordance between self-reported shoulder symptoms and physician diagnoses was not significantly correlated. Only 54% of subjects that reported no symptoms had a normal shoulder exam, and only 43% of subjects that reported symptoms had an abnormal physical exam (Kappa=0.02, p=N.S.). A minor abnormality such as winging may not be physically limiting, and may therefore go unreported. In fact, concordance of negative findings improve somewhat if scapular winging is not included in the analysis, resulting in 81% agreement. However, concordance between physical
exam shoulder abnormalities in symptomatic subjects is even lower, with only 20% agreement if winging is not factored into the analysis (Kappa=.02, p=N.S.).

Regression on Physician Findings

Any Neck Findings

There were only 2 variables that were significantly associated with any physician findings for the neck: working with a bent neck had an odds ratio of 1.7 (95% CI 1.02-2.81) and a protective effect from perceived support from supervisors with an odds ratio of 0.50 (95% CI =0.2-1.0); the Nagelkerke $R^2$ for the overall model was .086, with a -2 log likelihood=185.2. Neither age nor height was significantly associated with neck findings.

Experienced hygienists were 2.5 times (95% CI= 1.3-4.8) more likely to have some neck findings than the combined student groups when in a separate model; when the students were split, the student/assistants were 2.5 (95% CI= 0.76-8.0) times more likely, and experienced dental hygienists 4.4 (95% CI=1.5-12.6) times more likely, to have some neck findings than students (model r-square=.08; -2 log likelihood= 207.1).

Any Shoulder Findings

There were no significant associations with "any physician shoulder findings" in logistic regression, either with inclusion or exclusion of winging as the dependent variable.

Any Neck or Shoulder Findings

Experienced dental hygienists were 2.3 times (95% CI= 1.1-4.6) more likely to have some neck or shoulder findings (excluding winging) than the combined student groups when in a separate model. When the two student groups were split out, student/assistants had a non-significant odds ratio of 1.8 (95% CI=0.65-5.0, N.S.) and experienced a 3.2 odds ratio (95% CI= 1.3-7.9).

Discussion

This study examined the occurrence of neck pain among dental hygiene students, dental assistants, and experienced dental hygienists, and compares their relative exposures to biodynamic risk factors. The study found a significantly increased prevalence of reported neck pain and physical exam abnormalities related to the neck among experienced dental hygienists compared to dental assistants and dental hygiene students. Self-reported neck symptoms were 37% for DS, 43% for DA, and 72% for DH; physician neck findings ranged from 22% (DS), 38% (DA) and 47% (DH). These differences remained significant when controlled for age. Risk factors showing significant differences by group included working with a twisted neck, bent neck, static posture for the arms, using precise motions, and repetition. A supportive supervisory environment appeared to be protective. Experienced hygienists were 2.5 times more likely to have physician findings of the neck compared to the combined student group. Students who had previously worked as dental assistants demonstrated an intermediate risk of reported neck pain. This observation suggests that biodynamic hazards exist among dental assistants and that one cannot assume that students constitute a nonexposed population (and that, in addition, there are also substantial clinical exposures as part of training). Findings are consistent with prior research that neck and shoulder problems are apparent in this population and that low level loads are less associated with glenohumeral joint/rotator cuff issues than neck pain (as per physician findings). Neck issues are especially important to consider because they may be precursors to further problems in the more distal extremity.50,51

Significant associations between biodynamic exposures and abnormal physician exam findings were seen in each group when analyzed independently of the other groups. However, regression findings are more complex to interpret among the experienced hygienists who were by definition older and treated more patients per day than students (although age was not significantly associated with symptoms in most analyses). In addition, subject height and supervisor support were significantly associated with physician findings. A complex pattern emerges in which the relationship between biomechanical variables (such as bent neck, static posture, and repetition), anthropometric subject characteristics (taller height, which may result in more bending of the neck), and psychosocial support may combine to produce high levels of symptoms.
There are study characteristics that impact interpretation and generalizability. The unavoidable correlations between age and professional status make it more difficult to determine the proportion of the problem that is due to aging versus work (though the high level of symptoms and physician findings make it unlikely to be due primarily to aging, particularly given the associations with biomechanical variables). While the study included a longitudinal component, the great difficulty in follow-up of graduated students complicated interpretation of that component, thus it is not presented here.

While response rates were high for students, they were lower for experienced hygienists. While low response rates are not unusual for lab-based studies involving extensive time commitments, this raises the possibility of a sample of experienced hygienists that is biased towards more symptomatic (ie, that those with symptoms were more interested in participating). However, the rates of overall musculoskeletal disorder (MSD) symptoms, though very high, are in line with other studies of dental hygienists, the stepwise increase with dental assistants in the middle, and the consistent relationship with exposures all suggest similar conclusions, even if the rates of symptoms for experienced hygienists were biased to high. In addition, there is a likely healthy worker effect, which would bias towards lower prevalence for experienced hygienists compared to students (ie, that more symptomatic hygienists may drop out of the profession or reduce hours).

Conclusions

This large study utilizing both subjective and objective assessments, found that risk of neck and shoulder disorders among dental hygienists increases with a background of dental assistant work, and that neck symptoms are considerably more prevalent than shoulder symptoms (with a very low prevalence of rotator cuff tendonitis), and that neck bending, supervisor support, and holding arms above shoulder height are the key risk factors to address in prevention programs.

These high rates of risk factors and symptoms have serious implications for career loss, discomfort, disability, and productivity for dental hygienists. Musculoskeletal disorder (MSD) symptoms for dental assistants also are high, particularly in relation to the relatively short number of years of exposure in this sample, indicating the likelihood of onset of symptoms early in one’s career and progressing further with continued exposure. It appears that symptoms start as early as the second year of dental hygiene school as students move into clinical work.

Results point to a clear need for serious ergonomic evaluation and intervention in dental hygiene and dental assisting work, particularly (based on this analysis) focused on improving neck posture through improved dental equipment, proper client positioning, stretching, and technique training. Supervisor support should also be emphasized to assist in reducing symptoms. Results of this study are currently being combined with the results of a related lab simulation of dental hygiene work to detail ergonomic risks and suggest specific improvements for a future publication.

While a recent survey by the American Dental Association found that some ergonomic training was common in the dental professions (98% of dental hygiene programs reported some ergonomic training), the survey did not address the extent of the training, such as the number of contact hours; for example, there was not a separate course in ergonomics in any of the dental hygiene programs. Given the magnitude of risk, further attention should be given to ensure adequate training as well as on-going assessments of practices in training, and specific attention should be given to students with previous experience as dental assistants, since risks appear to be higher.

Acknowledgements

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Notes

Correspondence to: Tim Morse TMorse@uchc.edu.

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Dental Hygiene Workforce Issues: A Minnesota Study

Sarah Verville Basile, RDH, MPH and David O Born, PhD

Sarah Verville Basile, RDH, MPH, University of Minnesota, School of Dentistry; David O. Born, PhD, University of Minnesota, Division of Health Ecology, Department of Preventive Sciences.

Purpose. This study was designed to explore the prevalence and reasons for withdrawal from the dental hygiene workforce. The study also assessed the reasons for maintaining an active license after withdrawal, and the factors that might entice an individual to return to the dental hygiene workforce.

Methods. A random sample was selected of dental hygienists licensed in Minnesota from the November 2003 State Board of Dentistry's dental hygiene licensing file. Data was collected from a mailed questionnaire containing 45 open-ended and close-ended questions. The final sample included 2672 dental hygienists actively licensed and residing in Minnesota. One thousand four hundred and twenty responded to the survey, for a response rate of 53%. From that sample, 129 participants indicated that they were licensed to practice in Minnesota but were not currently working (had withdrawn from the workforce). This study focuses on the responses of those 129 individuals.

Results. The prevalence of withdrawal was 9%, with the majority of the participants indicating that they did not plan to return to the dental hygiene workforce. The primary reason for withdrawal was child-rearing responsibilities, followed by health-related reasons, and pursuing a different career. A key difference between those who were active participants in the workforce and those who had withdrawn was related to income. The results of this study found that financial difficulties, death/disability of a spouse, and having older children were the primary factors that would entice a respondent to return as an active participant to the dental hygiene workforce.

Conclusion. This study suggests that dental hygiene workforce issues are of great complexity and are multifactorial in nature. The findings tend to confirm the results of previous work. It can be concluded that because of the nature of the work and the demands of the profession, it is likely that movement in and out of the dental hygiene workforce will continue to be an issue in the profession.

Keywords: Attrition, workforce issues, career change, reentry into the workforce, dental hygiene workforce

Introduction

For many years, dental hygienists have had an integral role in the promotion of oral health, wellness, and disease prevention. According to the US Department of Labor, Bureau of Labor Statistics, dental hygienists held about 148 000 jobs in the United States in 2002.¹ However, due to the fact that holding multiple positions is common, the number of jobs tends to exceed the number of dental hygienists.¹ More than one-half of all dental hygienists work part time, which is defined as
less than 35 hours a week. In addition, the dental hygiene profession is projected to grow much faster than the average for all occupations through the year 2012.

Currently, on both the state and national levels, dental hygiene is a profession that is in transition and is facing a variety of workforce challenges. For example, there have been several recent legislative changes in Minnesota in relation to the dental hygiene profession. Such changes include the ability to work in alternative practice settings, collaborative agreement practice, expanded restorative functions that include placing and carving restorative materials (amalgam, glass ionomer, stainless steel crowns, and composite), and placing pit and fissure sealants without approval and supervision by a licensed dentist. It is possible that these changes could aid in increasing access to dental care. With such progressive changes underway, it is an appropriate time to examine the current dental hygiene workforce in Minnesota. The results described in the following manuscript are drawn from a larger study that was conducted to examine dental hygiene workforce issues. One segment of the workforce that needs additional study is the individuals who retain an active dental hygiene license but have withdrawn from the workforce.

It is important to assert that the productivity of the dental hygiene workforce is a function of various factors, such as the number of years clinical dental hygienists actively participate in the workforce. It can be assumed that some dental hygienists leave the workforce for a period of time while still retaining an active license. Because they leave the workforce for unspecified periods of time, their career productivity diminishes. If the numbers are significant, the ability of the dental hygiene workforce to deliver oral health care could be overestimated. In an effort to explore this matter, a workforce study was undertaken with a specific focus on dental hygienists with active licenses who have withdrawn from the workforce.

The study examines the following: the prevalence of withdrawal from the dental hygiene workforce; the key differences that exist between those who are active participants in the dental hygiene workforce and those who have withdrawn; the effect that spouse's occupation, income, and educational attainment have on an individual withdrawing from the workforce; the reasons for withdrawal; plans, if any, to return as active participants to the workforce; the reasons why individuals who have withdrawn from the workforce maintain an active license; and the factors that might entice them to return to the workforce.

Review of the Literature

A review of the literature indicates that there has been a considerable amount of research conducted on dental hygiene workforce issues in the United States. When looking at productivity, the literature addresses several issues, including withdrawal from the workforce and the factors that contribute to its occurrence.

The dental hygiene workforce is comprised mostly of married female professionals, with the vast majority having children. According to some studies, the majority of dental hygienists tend to be under the age of 40. A study published in 1978 supports the notion that dental hygienists tend to be positioned in the upper portion of the socioeconomic community. The greater part of the profession have earned an associate degree, although a significant number hold bachelor's degrees. Approximately 25% of dental hygienists have a bachelor's degree, yet few have a master's or doctoral degree.

Most licensed dental hygienists are actively employed in clinical practice settings-the majority in solo and group practices. Of those who are employed in clinical practice, a large number work in one practice. The average number of years employed in the profession varies greatly from approximately 6 years to 16 years. Turbyne et al reported that dental hygienists work on average between 34 and 40 hours per week, which differs from the US Department of Labor, Bureau of Labor Statistics findings that reported >50% working 35 hours or less.

While most dental hygienists are employed in the profession, some are not. There are several studies that address why dental hygienists are not employed within the dental hygiene workforce. Such reasons include family responsibilities, continuing formal education, dissatisfaction with dental hygiene (work conditions, work itself), licensure (waiting to take licensure exam, moving soon so will not bother, failed boards, and no license), looking for dental hygiene...
work, employed in other work, health reasons, and personal reasons.\textsuperscript{17} One study indicated that of the dental hygienists who leave the profession, most do so temporarily.\textsuperscript{6} The bulk of dental hygienists leave the profession due to family/child-rearing obligations and/or responsibilities.\textsuperscript{2,4,5,6,8,15,21,22} Many dental hygienists indicated that they could be enticed or have the intention of returning to the profession.\textsuperscript{4,6} Some incentives for reentry include increased salary, increased benefits, improved infection control procedures, increased involvement in setting infection control policies, and more decision-making opportunities.\textsuperscript{4}

Some dental hygienists leave the workforce because they are dissatisfied with the profession. One might predict that those who are dissatisfied with the profession are likely to not be employed as a dental hygienist.\textsuperscript{3} In addition, it seems that the longer one works as a dental hygienist, the greater the likelihood of being dissatisfied.\textsuperscript{16} Limited growth and development, not intellectually stimulating, and too many dental hygienists in the market, are all reasons dental hygienists stated for not recommending the profession to others.\textsuperscript{15} Other reasons for career dissatisfaction include boredom, repetition, lack of variety, inadequate salary, lack of benefits (sick and vacation pay, medical insurance coverage, a retirement plan, and continuing education), concerns about infectious disease, lack of decision-making opportunities, physical and emotional demands, little or no opportunity for advancement, physical strain, injury, and/or fatigue.\textsuperscript{2,14,19}

When dental hygienists were asked what they thought the profession would offer them, they replied, respectability, an acceptable salary, stability and security, flexibility, and a chance to help others. It is not a surprise that dissatisfied dental hygienists have more negative attitudes toward the profession than those who are satisfied. Some additional reasons dental hygienists are dissatisfied are as follows: lack of respect from dentists and coworkers, monotony, lack of creativity, little mental stimulation, pressure for greater volume of work, lack of time for patient education, and limited benefits. However, it is interesting that both satisfied and dissatisfied dental hygienists criticize the profession for limited career growth, advancement, and legal restrictions.\textsuperscript{16}

In 1986, a dental hygiene manpower study was conducted in Tennessee.\textsuperscript{5} The study found that 74% of participants surveyed had remained in the profession since graduation and that the average time of licensure was 11.11 years. Of the dental hygienists who left practice permanently, approximately 50% did so due to family demands, while others left due to career dissatisfaction or retirement. A large percentage left the profession temporarily due to family responsibilities. One hundred percent of the dental hygienists who left practice, either permanently or temporarily, retained their Tennessee license. Within the sample, 80% of the respondents were married, 8% divorced, 8% widowed, and 4% single. Changes in work hours were experienced by 67% of the practicing dental hygienists. Reasons cited included family responsibilities, a decrease in patient load, return to school, decrease in financial demands, decrease in job availability, community activities, health-related disability, death of a dentist, and hours reduced by the employer.\textsuperscript{5}

A career retention study was conducted in Texas in 1999. The results revealed that the primary reasons for leaving dental hygiene practice were family responsibilities, boredom, salary, and lack of benefits. Respondents who remained in practice were more likely to have a certificate or associate degree, were unmarried, had fewer children, and were younger than those who had withdrawn from the workforce. The authors concluded that the individuals who remain in clinical practice are positively influenced by the salary.\textsuperscript{22}

Several manpower studies have been published in countries other than the United States.\textsuperscript{23-25} Many of these studies revealed the same issues concerning the dental hygiene workforce as those that have been conducted in the United States. Similar to the United States, dental hygienists tend to be female, work in general dental practices, and enjoy a level of satisfaction with the profession.\textsuperscript{23-25} Dental hygienists tend to leave the profession for reasons largely related to child-rearing responsibilities.\textsuperscript{23,24} However, many dental hygienists indicated that they had plans to return to the profession.\textsuperscript{23,24}

Overall, the research on this subject is extensive, but there are also noteworthy gaps in the literature. First, it does not contain a great deal of information about spouses' occupation, income, and educational attainment. It is known that females are more likely than males to withdraw from the workforce for periods of time, and that the majority of dental hygienists are female.\textsuperscript{2,4,9}\textsuperscript{-14} Withdrawal from the workforce could be contingent on spouse's income. This is important to know
because a temporary or permanent leave from the dental hygiene workforce tends to diminish career productivity and longevity. A 1979 study found that many dental hygienists were married to people in professional and technical professions, followed by managers and administrators, salesmen, and craftsmen. In addition, 2 studies in the 1970s found that many dental hygienists were married to dentists.

Second, few studies have explored the question of why dental hygienists maintain an active license after withdrawing from the workforce. This is important because it is possible that these individuals could be enticed to reenter the profession. Or, it is possible that some individuals use their license for "in case" reasons, such as the death of a spouse or a divorce. It is imperative to note that maintaining an active license serves to mislead researchers when they look at the numbers of individuals in the dental hygiene workforce.

Third, the literature does not explore the issue of dental hygienists who leave practice and then reenter. It is important to know what their plans are, if any, to return as active participants to the workforce. It would be of great value to know the average amount of time a dental hygienist might withdraw from the workforce before returning for workforce planning.

Fourth, if a dental hygienist leaves the profession entirely, what are they pursuing? One study found that 6% were working toward additional degrees. Of the dental hygienists surveyed, some had pursued professional programs such as business, dentistry, and law. Again, if a significant number of dental hygienists withdraw from the workforce to pursue other endeavors, it is virtually certain that productivity would be greatly impacted.

This study focused on questions related to Minnesota dental hygienists who have withdrawn from the workforce. In particular, it focuses on spouse's occupation, income, and educational attainment; why nonactive participants maintain an active license; the plans of the individual, if any, to return as active members to the workforce; and what those individuals are doing who have left the profession permanently.

**Methodology**

A group of Minnesota dental hygienists were identified who had maintained an active license and were residing in the state in November 2003 (n=3562). From that subset, a 75% random sample was drawn. The final sample included 2672 dental hygienists actively licensed and residing in Minnesota; 1420 responded to the survey, for a response rate of 53%. This study focused specifically on a subset of the 1420 respondents. The subset included 129 dental hygienists who had withdrawn from the dental hygiene workforce but maintained an active license.

Data were collected from a questionnaire containing 45 open-ended and close-ended questions. The questionnaire was developed by the authors, pilot tested, and revised. The pilot test was conducted by 5 clinical dental hygienists and 5 dental hygiene educators. Institutional Review Board (IRB) approval was obtained from the University of Minnesota.

The questionnaires, along with a cover letter, were mailed to 129 dental hygienists with a postage-paid return envelope. The cover letter explained the purpose of the study, the importance of the subject's participation, and that the subject's participation was voluntary. The letter addressed confidentiality issues and the appropriate time it would take to complete the questionnaire (20 minutes). In addition, it provided the contact information of the investigators.

A follow-up postcard was mailed to the nonresponders approximately 4 weeks after the first mailing. Also, the researcher's contact information was printed on the postcard to facilitate requests for a second copy of the questionnaire. Questions focused on the following areas:

1. Demographic information of dental hygienist and spouse (if applicable).
2. Current professional status.
3. Reasons for leaving the workforce.
4. Reentry considerations.

The entries to each question were coded, entered, and analyzed in Microsoft Excel®. The researchers used Microsoft Excel® to analyze all of the data and descriptive methods were utilized. This study investigated a small subset of the data...
collected for a larger project. Because so little is known about the individuals that withdrawal from the dental hygiene workforce, inferential analysis was delayed until the present data could be viewed in the context of the larger data set. Doing so may allow us to present a more coherent and complete picture of the decisions dental hygienists make over the span of their careers.

Results

There were 9.08% of the subjects who had indicated that they dropped out of the workforce for a variety of reasons. Because not all of the 129 respondents answered each of the questions, the number of responses to individual questions varied.

Demographic Information of the Participant

The demographic data included the year the participant completed their dental hygiene education, the highest academic degree achieved, the year they were born, marital status, and the number of children living in their household. Working and nonworking participant categorical demographic data is summarized in Table I.

Table I. Demographics Chart

<table>
<thead>
<tr>
<th>Actively Participating in Dental Hygiene Workforce (N=1291)</th>
<th>Not Actively Participating in Dental Hygiene Workforce (N=129)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age: 40.38</td>
<td>Average Age: 46.27</td>
</tr>
<tr>
<td>Average Year Completed Education: 1988</td>
<td>Average Year Completed Education: 1980</td>
</tr>
<tr>
<td>Highest Degree Obtained:</td>
<td>Highest Degree Obtained:</td>
</tr>
<tr>
<td>Associate Degree 69%</td>
<td>Associate Degree 53%</td>
</tr>
<tr>
<td>Bachelor's Degree 29%</td>
<td>Bachelor's Degree 41%</td>
</tr>
<tr>
<td>Master's Degree 2%</td>
<td>Master's Degree 5%</td>
</tr>
<tr>
<td>Doctoral Degree 1%</td>
<td>Doctoral Degree 2%</td>
</tr>
<tr>
<td>Children in Household:</td>
<td>Children in Household:</td>
</tr>
<tr>
<td>Do Not Have Children 37%</td>
<td>Do Not Have Children 33%</td>
</tr>
<tr>
<td>Under Age 5 23%</td>
<td>Under Age 5 28%</td>
</tr>
<tr>
<td>Ages 5-12 24%</td>
<td>Ages 5-12 26%</td>
</tr>
<tr>
<td>Ages 13-18 28%</td>
<td>Ages 13-18 22%</td>
</tr>
<tr>
<td>Over Age 18 11%</td>
<td>Over Age 18 16%</td>
</tr>
<tr>
<td>Marital Status:</td>
<td>Marital Status:</td>
</tr>
<tr>
<td>Single (Never Married) 11%</td>
<td>Single (Never Married) 1%</td>
</tr>
<tr>
<td>Married 79%</td>
<td>Married 88%</td>
</tr>
<tr>
<td>Divorced 9%</td>
<td>Divorced 9%</td>
</tr>
<tr>
<td>Widowed 1%</td>
<td>Widowed 2%</td>
</tr>
</tbody>
</table>

The mean age of the participants who had withdrawn from the dental hygiene workforce was 46.27 years old and had completed their dental hygiene education between 1940 and 2001 (mean=1980). Mean age for the working group was 40.38 years old and had completed their education between 1942 and 2003 (mean=1988). Many of the subjects in both groups held associate degrees; however, it is important to note that several held bachelor's degrees, while a few held
master's and doctoral degrees. The educational attainment of the individuals who have withdrawn was higher than the participants who were actively working in the profession. The majority in both groups were married, however, more participants in the working group were single as compared to the nonworking group. Both groups included a similar number of participants who were divorced or widowed.

When asked if they had children living in the home, 67% of nonworking and 63% of working dental hygienists responded to the affirmative. The respondents were also asked to indicate the number of children living within the household in each age category.

Information related to spouse's demographics is presented in Table II. Nonworking participants tended to be married to individuals that were more highly educated. In addition, 23% of nonworking participants indicated that their spouses earned between < $10,000 and $49,000, while 77% earned between $50,000 and $200,000 or more, annually (Table II). The active participants indicated that 38% of their spouses earned between < $10,000 and $49,000, while 63% earned between $50,000 and $200,000 or more, annually (Table II). Forty-one percent of nonworking dental hygienists had spouses who earned between $100,000 and $200,000, annually. Eighteen percent of working dental hygienists had spouses that earned between < $100,000 and $200,000, annually. Those individuals in both groups in the less than $10,000 category were mostly retired, although a few were unemployed, stay at home parents, and students.

<table>
<thead>
<tr>
<th>Spouse’s Demographics Chart</th>
<th>Active Participants versus Nonactive Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Degree Obtained by Spouse:</td>
<td>Highest Degree Obtained by Spouse:</td>
</tr>
<tr>
<td>No Formal Education</td>
<td>21%</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>27%</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>32%</td>
</tr>
<tr>
<td>Master's Degree</td>
<td>12%</td>
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<tr>
<td>Doctoral Degree</td>
<td>8%</td>
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<tr>
<td>Spouse’s Income:</td>
<td>Spouse’s Income:</td>
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<tr>
<td>Less than $10,000</td>
<td>2%</td>
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<tr>
<td>$10,000-$14,999</td>
<td>1%</td>
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<tr>
<td>$15,000-$24,999</td>
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<td>$25,000-$34,999</td>
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<tr>
<td>$150,000-$199,999</td>
<td>3%</td>
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<tr>
<td>$200,000 or more</td>
<td>3%</td>
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</table>

Spouses’ occupations were categorized based on the US Department of Labor, Bureau of Labor Statistics job classifications, which contains 22 categories. Each category included detailed examples of the occupations they represented. Two additional categories were added to better categorize some of the individuals. The first category was business owner and self employed. The second category was retired, unemployed, student, and stay at home spouse.
Some respondents did not give a detailed description of their spouse's occupation; therefore, these responses were categorized based on the best possible fit. This was also true for the occupations that were not found in the Bureau of Labor Statistics categories. For example, many subjects indicated that their spouse's occupation was management, while others gave a detailed description (e.g., chief executive officer for a major bank). Because of these responses, all management positions, regardless of level, were classified in the management occupations category. Another example was classifying a mortician. Mortuary science was not found in any of the Bureau of Labor Statistics categories; therefore, an educated estimate was made and this profession was placed in the life, physical, and social sciences occupations category.

Nonworking dental hygienists tended to be married to spouses from the following categories: management occupations (19%), healthcare practitioner and technical occupations (17%), business owner/self employed (11%), and retired, unemployed, student, and stay-at-home spouse (11%). All spouses who were not working were retired.

The participants active in the dental hygiene workforce tended to be married to spouses working in the following categories: management occupations (17%), construction and extraction occupations (9%), sales and related occupations (8%), and health care practitioner and technical occupations (8%).

**Current Professional Status**

Several nonworking participants (n=11) indicated that they were not employed as dental hygienists but were currently seeking dental hygiene positions. Most of the respondents were looking for part-time positions, one was looking for a full-time position, and 2 specified that they would accept either full-time or part-time work. Of those seeking part-time positions, most were doing so due to child-rearing responsibilities. Other reasons included getting out of the house, spouse travels for work, and burnout. The respondents had been seeking employment anywhere from one week to one year.

All of the individuals responded that they were restricting their job search to a specific geographic region due to having family/children/friends in the area, spouse's employment situation, and because they wished to remain in the area. When asked how far they would be willing to commute to work as a dental hygienist, the mean response was 37.72 miles roundtrip. One hundred and eighteen participants (92%) were not currently working as a dental hygienist and not currently seeking employment in the dental hygiene field.

The nonworking participants were asked how long it had been since they left the dental hygiene workforce. The responses ranged from < 1 year to 25 years (Figure 1). All the participants had worked as a clinical dental hygienist at some time in their career.
Nonworking dental hygienists were asked why they ceased working as a dental hygienist. The primary reason was child-rearing responsibilities. Additional reasons cited included health reasons, changed career, other, retired, and income unsatisfactory, respectively. Other reasons cited by respondents included bored or dissatisfied with the profession, poor relations with the dentist, lack of dental hygiene employment opportunities, and caring for others (such as an elderly or ill parent).

When asked why they maintain an active dental hygiene license, the majority indicated it was in case additional income is needed at some point in the future. Other reasons cited were in case spouse is unable to work (n=52), other (n=43), will resume when children are older (n=34), and in case I am unable to find other work (n=34). Loyalty to the profession was added because several participants (n=14) had noted this response in the "other" category. Overall, the "other" responses were as follows: mission/volunteer work, licensure is needed for my current (nonclinical dental hygiene) position, and I fill-in at a dental practice. Many indicated that they plan to resume work as a dental hygienist in the future. However, 5 individuals noted that they would be dropping their licenses at the end of the year.

Respondents were asked if they anticipate reentering the dental hygiene workforce at some point in the future, and if so, when? Forty-two percent indicated that they were planning to return to the dental hygiene workforce, while 58% indicated that they were not planning to return. Of those planning to return to the profession, the average time to reenter was planned as 2.42 years, the standard deviation was 1.98, and the range was 6 months to 10 years.

Of those who did not plan to reenter, the most common reason was child-rearing responsibilities, with 50 total responses. Health reasons was the second most common reason, followed by other, retired, better employment in another field, lack of jobs, and lack of child care, respectively.

Finally, individuals were asked what it would take to get them to reenter the dental hygiene workforce. The participants were asked to check all responses that applied. There were 288 total responses. The most prevalent responses were financial difficulties (65), death/disability of a spouse (50), and having children be older than they are now (42). The next most noted responses were as follows: other (33), divorce (29), job offer at an attractive wage (23), fringe benefits (23), currently looking for a dental hygiene position (8), being healthier (8), and relocating to a different community (7). Some of the most indicated "other" responses included finding a "good" dentist to work for, I would return if something bad happened.
in my current career, nothing could get me to return, if other opportunities were available such as independent practice, more skill variety, and/or a nonclinical position became available.

**Careers Other Than Dental Hygiene**

Many of the subjects indicated that they were not employed in the dental hygiene workforce because they are working in careers other than clinical dental hygiene. Several participants indicated that it was mandatory or they felt it was important to maintain their dental hygiene license in order to work in their current positions. Such positions included: health care research, computer software implementation, dental assisting instructor, sales, consulting, and dental benefits administration. The remaining participants were in careers that did not necessarily require dental hygiene licensure. Positions held by these participants were as follows: flight attendant, writer, artist, dental technician, medical transcriptionist, trainer, real estate, business owner, medical social worker, health information technology, business, procurement manager, paralegal, nurse, researcher, and epidemiology.

Seven participants noted that they were enrolled in academic programs other than dental hygiene. Reasons for this included: being unable to find a position in dental hygiene, physically unable to practice dental hygiene any longer, bored with the profession, underappreciated, and lack of advancement in the field. Some individuals were enrolled in bachelor and doctoral programs.

A comparison was made between those who had temporarily left the dental hygiene workforce and those who had left permanently. Fifty-eight percent (n=66) indicated that they do not anticipate reentering the dental hygiene workforce. These individuals were placed in the Permanently Left Profession category. Forty-two percent (n=48) anticipate reentering the dental hygiene workforce in the future. These participants were placed in the Temporarily Left Profession category.

The subjects were asked how many years it had been since they were last employed as a dental hygienist. Those who had permanently left the dental hygiene workforce had been out of work an average of 7.63 years; those who had left temporarily had been out for an average of 3.07 years. The participants who anticipated returning to the workforce were asked to answer the question, in approximately how many years would you reenter? The mean response was 2.53 years. Fifteen participants did not respond to the questions regarding whether or not they planned to reenter the dental hygiene workforce.

Both groups were asked why they ceased working as a dental hygienist. Those who had left the workforce permanently indicated doing so because of the following: health reasons (26%), child-rearing responsibilities (30%), pursuing a different career (29%), and retired (26%). The individuals that had left the workforce temporarily did so because of the following: health reasons (17%), child rearing responsibilities (75%), pursuing a different career (10%), and retired (0%).

**Discussion**

The purpose of this research was to determine which factors influence dental hygienists to withdrawal from the dental hygiene workforce and what it would take for them to reenter. This study had a 53% response rate, thus, yielding a sample of 1420 individuals. While similar studies have had an overall higher response rate, few had a sample size as large as this study. 2,3,5,11,15,20,22-24

Of the 1420 respondents, 129 participants (9%) were not currently employed as a dental hygienist but maintained an active license. The withdrawal rate of 9% in the current study is similar to the findings of Miller’s 1990 study, in which the attrition rate was estimated to be between 5% and 10%. 2 A similar study found that of those who leave the workforce, most do so temporarily. 3 The current study found that less than one-half of those who withdrew from the workforce anticipate reentering in the future.

The results of this research yield important demographic information about the individuals who are not active participants in the dental hygiene workforce and also about those who are active participants in the dental hygiene workforce. The individuals who were not active in the dental hygiene workforce tended to be older (on average 6 years older than those in the working group), had completed their dental hygiene education 8 years earlier than the participants in the working group, and held higher degrees. They were more likely to be married, have children, with a number of them having younger
children than those in the working group. It is important to note that several of the nonactive individuals were actually working; however, many of them are pursuing careers outside of clinical dental hygiene practice.

The career mobility of dental hygienists with spouses whose occupational status and salary are higher, demonstrates movement out of the labor market. This could be a function of spouse's characteristics rather than of the dental hygienist's individual needs. This study found that the participants who have withdrawn from the workforce are married to spouses whom, on average, have higher incomes and have achieved a higher level of education than those individuals who are active in the workforce. For the nonactive dental hygienists, it was found that nearly one-half of the spouses were employed in occupations in the management, health care, and business owners (or self employed) categories. Respondents who were active in the workforce tended to be married to individuals in occupations such as management, construction and extraction occupations, sales and related occupations, and health care. From the responses generated from the survey, when a spouse is earning a higher income, the licensee is likely to pursue other endeavors. For example, they are able to pursue a career other than dental hygiene and/or return to school to earn a higher degree.

The reasons for withdrawal from the dental hygiene profession were also investigated. The participants who do not plan to return to the workforce had been out from dental hygiene employment longer than those who plan to return. Because of this greater lapse in time, it is likely that those who do not plan to return to the profession actually will not. Many studies have found that child-rearing responsibilities are the primary reason for withdrawing from the workforce. This finding was confirmed in this study. Child rearing was the most frequently cited reason for not working in dental hygiene by all groups. It is interesting to note that of the respondents who anticipate returning to the workforce, 75% indicated that the withdrawal was due to child-rearing responsibilities, while 30% of those who do not anticipate returning responded the same. Because of this difference, it does not seem that child rearing is a reason for permanently withdrawing from the profession. In addition, the participants who anticipated a return to the workforce indicated, on average, that they would return in 2.53 years.

When the participants were asked why they ceased working as a dental hygienist, the second most noted answer was due to health-related reasons. Therefore, this study supports the literature on this issue. In addition, it might be of value for dental hygiene curriculums to educate students about careers related to dental hygiene, such as dental professional sales, dental hygiene research, and dental hygiene education. Because health-related reasons seem to be an important factor for withdrawal, dental hygienists should be educated on alternative career choices.

Career change was another reason for withdrawing from the dental hygiene workforce. This was found to be true mostly within the population that does not anticipate returning to the workforce. When asked why they ceased working as a dental hygienist, 16% indicated that they were pursuing another career. Some of the individuals noted that maintaining their license was required for their current position, while others indicated that this was not the case. It is important to note that while all withdrawals contribute to the diminishment in dental hygiene clinical practice productivity, many are also contributing to the dental hygiene profession via research, dental hygiene education, consulting, marketing and sales, nonclinical public health positions, and dental insurance management. Therefore, their withdrawal should not be considered a detriment to the profession. Dental hygiene educational programs should account for such losses and also educate students about careers related to dental hygiene, which could at some point be considered an alternative to clinical dental hygiene practice.

This leads to the question of why individuals retain an active license to practice dental hygiene. A number of individuals stated that they plan to resume when their children are older. However, more subjects indicated that they were retaining a license as a backup, in case their situation should change in the future. For example, many responded that they retained their license in case additional income is needed, in case spouse is unable to work, or in case they are unable to find other work. Therefore, it is likely that such individuals would not choose to return to the profession unless a major change occurred within their household.

It is possible that some dental hygienists could be enticed to return to the profession if certain conditions were different. One such condition would include a change in their personal life that would require the individual to return to work. Or, an individual might be more likely to be an active participant in the workforce if they felt that they were being sufficiently compensated for their work and/or if the job offered adequate fringe benefits. This is an important finding because it reveals that, while an individual may or may not have withdrawn from the workforce for these reasons, they could be
enticed to return because of them. It would be beneficial for employers of dental hygienists to be aware of this finding in order to entice them to remain working.

Because of the nature of the work and the demands of the profession, it is likely that movement out of the dental hygiene workforce is always going to be an issue. However, according to the US Department of Labor, Bureau of Labor Statistics, dental hygiene employment is expected to grow much faster than the average for all occupations through the year 2012. This projection rests on assumptions about the increasing demand for dental care and the greater utilization of dental hygienists to perform services previously performed by dentists. If such an assumption were true, the way in which people access dental care could change, which in turn, would likely have a great effect on public policy. This effect on public policy would mean that dental hygienists could be responsible for more expanded duties and the workforce would need to be staffed to meet such changes.

**Conclusion**

While this research only included Minnesota dental hygienists who hold an active license, it did not include individuals who have been licensed and for one reason or another terminated that license. Future research might include studies to determine the reasons for termination, what factors might have changed their decision, and the reasons for their withdrawal from the workforce.

The findings from this study tend to confirm the results of related work. In addition, this study suggests that dental hygiene workforce issues are of great complexity and are multifactorial in nature. This study yielded the following results:

- In general, 9% of dental hygienists in Minnesota withdrew from clinical practice.
- There are key differences between those who are active participants in the workforce and those who have withdrawn.
- Spouse's income is a factor that contributes to withdrawal.
- The primary reason for withdrawal is child-rearing responsibilities, followed by health reasons, and pursuing a different career.
- Most of the individuals indicated that they do not plan to return to the clinical dental hygiene workforce.
- Having financial difficulties, death/disability of a spouse, and having older children were the primary factors that would entice a respondent to return as an active participant to the clinical dental hygiene workforce.

As dental hygiene educational programs plan for future enrollments to meet projected demands, they would be advised to consider the attrition figures identified in this study and to explore and address, to the extent possible, the factors contributing to withdrawal from the dental hygiene workforce.

**Acknowledgements**

**Notes**

Correspondence to: Sarah Verville Basile at vervi001@umn.edu.

**References**

Myasthenia Gravis: A Review for Dental Hygienists

Lynn Tolle, BSDH, MS

Lynn Tolle, BSDH, MS, professor and director of clinical affairs, School of Dental Hygiene, Old Dominion University, Norfolk, VA.

Myasthenia Gravis (MG), an autoimmune disease causing fluctuating weakness in the voluntary muscles, leads to various degrees of neurological dysfunction. Typically exhibiting a slow but progressive course, the disease may become fatal when muscles of respiration fail. Appropriate dental hygiene management of patients with this disorder is contingent upon an understanding of disease etiology, clinical characteristics, pharmacological interventions as well as oral manifestations. With this information, dental hygienists will be better prepared to provide safe and effective treatment to patients with MG and may prevent a life threatening crisis from developing during dental hygiene care.

Keywords: myasthenia gravis, patients with special needs, dental hygiene, neuromuscular disorder, autoimmune disorder

Introduction

Myasthenia Gravis (MG), the most common of the neuromuscular transmission disorders, affects both genders and all ethnic groups with an incidence rate of 7 per 100,000 people. Muscle weakness and fatigue characterize this autoimmune disorder and the oral pharyngeal area is commonly affected. With enhanced treatment interventions decreasing mortality, improved diagnostics, and the aging of the population, the incidence of this disease is increasing. The purpose of this article is to provide an overview of MG pathophysiology, clinical characteristics, treatment options, and strategies for appropriate dental hygiene management.

Characteristics

Two peak incidence ages for women, 20 to 40 and post 70 years of age have been reported. In men, the average age of onset is after age 50, but Myasthenia Gravis (MG) may appear at any age. The most distinctive feature of MG is weakness of voluntary muscles, made worse by use and reduction of weakness with rest. In most individuals, upper extremity weakness is more prevalent than lower extremity weakness. The highly variable clinical course is usually progressive and relapses and remissions can occur. Increased body temperatures, pregnancy, emotions, hormonal changes, medications that affect neuromuscular transmission, illness, and/or infections are associated with disease exacerbation. Persons with MG typically feel stronger in the morning with fatigue progressively getting worse toward evening. Regardless of the time of day, with prolonged exertion, affected muscles become fatigued and weak. Most commonly, the muscles of the eyes, neck, throat, tongue, and face are affected early in the course of the disorder. The weakness often becomes more generalized, spreading to other muscles innervated by the cranial nerves, including those that control breathing and extremity movements.
Onset of symptoms is often gradual starting with weakness in ocular muscles. The medial rectus muscles are the most severely affected. Movement of the eye and eyelids are initially affected with the levator palpebrae, orbicularis oculi, and extraocular muscles becoming involved. As a result, the patients often experience diplopia, ptosis and nystagmus. Asymmetrical ptosis, or drooping of the eyelid, is a hallmark sign of MG. To compensate for ptosis, the frontalis muscle may be contracted, creating a worried or surprised look on affected persons. Because onset of ocular symptoms is often slow, many individuals may experience symptoms for years and not be aware they have MG. Problems when reading often is the impetus for individuals to seek medical care from an ophthalmologist. Symptoms remain localized to the ocular area in approximately 15% to 20% of persons with MG. Typically, the disease does not become generalized if it remains ocular for 3 years. However, 2 years post diagnosis, almost all patients have unilateral or bilateral ocular involvement.

**Oral Manifestations**

Approximately one-fourth of diagnosed Myasthenia Gravis (MG) patients have bulbar muscle involvement, so named for the nerves originating from the brain stem's bulb like portion. With bulbar involvement, muscle weakness causes problems with swallowing, choking, facial movement, holding up the head, and articulation. Weakness of the muscles of mastication is common and ability to eat becomes difficult. Patients may not be able to chew and swallow, making eating such an unpleasant experience that dehydration and malnourishment may result. With time, facial muscle involvement causes the patient to display a lack of facial movement. Smiling attempts result in a characteristic snarling or transverse appearance, and the corner of the mouth droops and may hang open.

Palatal and pharyngeal muscle involvement cause speech difficulties including slurring, alteration of voice, and dysarthria. Myasthenic speech tends to sound nasal due to weakness of the soft palate and dysarthria results from lack of control and execution over speech muscles. As the laryngeal muscles are affected, voice alteration occurs with changes ranging from breathiness and softness to hoarseness.

**Generalized MG**

In most persons with Myasthenia Gravis (MG), muscle weakness spreads from ocular and oropharyngeal muscles to the upper and lower extremities, resulting in a generalized form of MG. First affected are the upper extremities, with patients experiencing problems raising their arms over the head and rising from a sitting position. Due to specific weakness in the small muscles of the hand, performing fine motor tasks such as writing or performing oral self-care may become problematic. Neck flexors, deltoids, hip flexors, and finger/wrist extensors are muscles most commonly affected in the generalized form. The most significant effect of MG results when there is weakness of the intercostal muscles and the diaphragm. Affecting 20% to 40% of persons with MG, respiratory muscle weakness can be life threatening resulting in a myasthenic crisis, an acute exacerbation of symptoms with respiratory failure. Shortness of breath and an inability to swallow, cough, and clear secretions often leads to respiratory distress, and requires ventilator support. Prior to effective pharmacological interventions, 40% of the mortality rate associated with MG was due to respiratory arrest.

Electromyography testing, edrophonium test, and antibody tests are used in conjunction with the clinical and neurological history and exam to support a diagnosis of MG.
Pathophysiology

Myasthenia Gravis (MG) is the best understood of the various autoimmune diseases and affects the neuromuscular junction postsynaptically. Acetylcholine, a protein on muscle cells required for muscle contraction, is a key player in the pathogenesis. Acetylcholine is normally stored at the terminal end of axons. It travels through the neuromuscular synapse, binds to acetylcholine receptor sites on the folds of postsynaptic motor end plates, depolarizes, and stimulates a muscle contraction.

In 85% of patients with MG, the pathophysiology involves the formation of antibodies to acetylcholine receptors (AChR). These antibodies cause an interrupted connection between the nerve and muscle. Acetylcholine receptor sites (AChRs) are a docking area for acetylcholine (ACh). The antibody attack blocks, alters, and reduces the number of acetylcholine receptor sites, preventing nerve impulse conduction along the normal pathway at normal conduction speeds. Research about the pathophysiology of MG reveals this immune dysfunction occurs in 3 ways, which primarily alter depolarization of muscle tissue at the postsynaptic membrane. These mechanisms include a complement-dependent destruction of ACh at the postsynaptic membrane, circulating antibodies with 2 binding sites, causing an enhanced rate of internalization and destruction of AChRs and antibodies to AChR invading and inhibiting the receptors directly. Therefore, due to a lack of ACh, normal impulse transmission is disabled because receptors at the myoneuronal junction cannot depolarize. In affected individuals, anti-ACh receptor antibodies may destroy up to 89% of receptor sites per neuromuscular junction.

The thymus gland has also been implicated in the pathogenesis of MG but it is not known whether thymic changes play a primary or secondary role in disease pathogenicity. Approximately 90% of MG patients have altered function of this gland and 10% to 15% of patients have a thymic tumor. Thymoma, hyperplasia of the thymus, frequently occurs, but the relation to MG is not clear. The thymus may cause the autoimmune dysfunction through an overproduction or prolonged synthesis of thymic hormones.

Treatment

Treatment for Myasthenia Gravis (MG) primarily consists of 5 options, 3 of which are pharmacological interventions that may have an impact on dental hygiene care. Treatment, however, is highly individualized since patients do not respond favorably to all options. Rate of disease progression, degree of functional impairment, age, and the distribution of muscle weakness all influence treatment choices.

In general, cholinesterase (CHE) inhibitors are the first therapy of choice. These drugs inhibit breakdown of ACh so it can accumulate at the neuromuscular junction. Pyridostigmine bromide (Mestinon®) and neostigmine bromide (Prostigmin®) are the CHE inhibitors most commonly prescribed for MG. Optimal dosage varies amongst patients but improvements can be seen in 30 minutes to 40 minutes after taking, and last from 3 hours to 4 hours. Following prescribed, optimal dosage recommendations is very important as toxic amounts of CHE inhibitors may cause a cholinergic crisis, resulting in muscle weakness and possible respiratory collapse.

Most patients with MG will also require immunosuppressive therapy. Corticosteroids, often used in combination with pyridostigmine, are prescribed when patients do not respond to CHE inhibitors alone. Steroids may inhibit antibody formation, with prednisone being the corticosteroid of choice. Other immunosuppressive drugs such as azathioprine (Imuran) or cyclosporine (Sandimmune) may decrease the immune stimulus for ACH receptor antibody production. However, benefits must be closely weighed against side effects and enhanced risk of infection. These immunosuppressants may replace or be used in combination with steroids.

Thymectomy, the surgical removal of the thymus gland, improves symptoms in some individuals but the response is unpredictable. This therapy is limited to individuals under the age of 60 who are medically stable and those individuals with a thymoma.
When patients with MG are in a critical situation such as a myasthenic crisis or in preparation for surgery, plasmapheresis is a recommended therapy. This treatment involves plasma exchange where AChR antibodies are removed from the circulating plasma. Positive effects are fast but transient, and until other medications can be effective, provide short-term relief of symptoms. \(^{21,22}\)

**Dental Hygiene Considerations**

Promotion of maximum wellness and prevention of complications is the treatment paradigm for Myasthenia Gravis (MG). \(^{12}\) Consultation with the patient's physician to determine if the patient's MG is stable and controlled should be conducted prior to any dental treatment. \(^{24,25}\) Patients with uncontrolled MG would most likely need treatment in a hospital setting. Because any infection, including those of dental origin may cause disease exacerbation and lead to a myasthenic crisis, control of dental and periodontal infections is critical. Dental hygienists should play an integral role in educating patients with MG on the importance of adopting preventive and therapeutic interventions that will promote oral wellness. Oral musculature dysfunction and weakness of the hand muscles, causing poor motor control, are common findings that may increase the risk of oral infection.

Several modifications in dental hygiene treatment planning are necessary to ensure a safe and effective appointment. Important educational topics for the patients are listed in Table I.
A thorough review of the patient's medications is critical to prevent serious complications during dental hygiene care. Patients taking anticholinesterase medications may experience serious reactions with other medications used in dentistry creating a health crisis. (Table II) When patients need local anesthetic agents for periodontal debridement, ester-type anesthetics such as procaine (Novacaine) should be avoided. These types of anesthetic agents are metabolized slower due to hydrolysis by plasma cholinesterase, which increases the risk of a toxic reaction. Amide type of local anesthetic such as lidocaine and mepivacaine are recommended. Before prescribing any antibiotics, consultation with the patient's physician is warranted, as a wide array of antibiotics have been found to cause muscle weakness. In general, aminoglycosides, ciprofloxacin, erythromycin, clindamycin, and tetracycline should be avoided. Penicillin and erythromycin do not cause neuromuscular blocking and can be safely prescribed.
Patients should receive dental hygiene care at the time of day when CHE inhibitor medication has maximum effectiveness, typically within 1 and 1 ½ hours after taking. As stress may cause disease exacerbation leading to a myasthenic crisis, a stress free as possible appointment is imperative. Effective pain management, soothing music, elimination of extraneous noises, aromatherapy, and anticipatory guidance may promote relaxation and less stress during dental hygiene care. In some situations, use of sedatives may be helpful. For patients experiencing articulation problems, having a caregiver or loved one in the treatment area may facilitate enhanced communication and provide reassurance to the patient.

Because of weakened oral pharyngeal musculature, many patients are at high risk for pulmonary aspiration. Ultrasonic scaling devices and air polishers are therefore, contraindicated. During the appointment mouth props are a useful adjunct due to oral musculature fatigue and use of high speed suction is imperative to prevent oral debris from being aspirated. Ocular involvement requires avoidance of the dental light in patients’ eyes as much as possible and dark protective-type lenses that will facilitate less eye strain for the patient during the appointment.

Dental hygienists must be knowledgeable about patient signs suggesting a myasthenic or chlorgenic crisis. A patient's first complaint of dyspnea at rest must be taken seriously. Symptoms that may seem minor can quickly escalate to a life threatening respiratory condition. The inability to swallow, speak or maintain an open airway, double vision, tachycardia, dysphagia, and profound muscle weakness are key signs of a myasthenic crisis. Often due to increasing muscle weakness,
patients increase their dosage of acetylcholinesterase medication not understanding that excessive doses will not relieve fatigue, but lead to increased muscle weakness and possible respiratory failure. Signs of a cholinergic crisis include abdominal pain, diarrhea, excessive pulmonary secretion and respiratory distress. \textsuperscript{29,30} Hence, reminding patients to take their medication exactly as prescribed is very important. Dental hygienists must be prepared to maintain an open airway and call for emergency assistance if these types of symptoms are displayed by a patient with MG.

Each of the 3 drug regimens used in treating MG have side effects that may alter dental hygiene care. Patients on long term corticosteroid involvement need to be medically evaluated for possible premedication due to immune suppression. Patients should also be evaluated for adrenal insufficiency, which would require supplemental glucocorticoid medication prior to treatment.\textsuperscript{31} In addition, osteoporosis is a common side effect of long-term corticosteroid therapy and may lead to oral bone loss. Bone density screening tests should be recommended to patients on long-term corticosteroid therapy.\textsuperscript{18}

Antibiotic premedication may be necessary for those patients taking cyclosporine or azathioprine due to immune suppression resulting from these drugs.\textsuperscript{26,31} An increased incidence of fungal infections may also be encountered as well as a slower recovery from periodontal debridement due to prolonged wound healing. Another consideration is that anticholinesterase drugs may cause excess salivation and drooling, leading to excessive supragingival calculus formation. Use of tarter control toothpaste might be recommended to facilitate control of excess calculus deposition supra-gingivally. Anticholingeric drugs to control the excess salivation must be avoided.

In order to provide compassionate and quality care, dental hygienists must realize that energy conservation is critical to the well being of patients and plan hygiene appointments accordingly.\textsuperscript{32} Ensuring that patients have a handicapped parking space or one close to the office will facilitate less patient fatigue. Mid-morning appointments are an ideal time to schedule appointments, as muscle weakness will not be as pronounced as later in the day and the patient will have more time to conserve energy while getting ready. Because short appointments are necessary, having patients' complete medical history forms before they arrive and use of a hygiene assistant will promote efficiency and is highly advisable.

Dental hygienists must be cognizant that disease status often influences self-care practices. Patients will experience times when oral self-care is better than others depending on disease remission and exacerbation affecting fatigue levels and oral-pharyngeal and hand muscle weakness. Having realistic expectations about what a patient can accomplish and being encouraging at all times is an important strategy for providing compassionate and quality care.\textsuperscript{32,33} To control oral infection, frequent re-care should be encouraged with the interval time shortened from 3 months to 2 months if self care ability is compromised for an extended time period. Powered toothbrushes and flossing devices may facilitate effective self-care practices and conserve energy. Alternative manual toothbrush head designs such as the Surround R toothbrush can be recommended if finances preclude the purchase of powered devices. The Surround tooth brush R has bristles designed to surround the teeth to remove plaque biofilm from the facial, lingual, and occlusal surfaces simultaneously, reducing the number of brushing strokes required. For some patients, extending or enlarging the toothbrush handle may prove helpful. Although antimicrobial rinses can minimize oral infections, the oral musculature dysfunction experienced by many MG patients may limit rinsing ability. As a result, caution is advised when recommending mouth rinses. For some patients, toothettes dipped in chlorhexidine or antimicrobial oral rinses used in an oral irrigation device may provide some antimicrobial benefits if rinsing is not possible. For patients with ocular involvement, modifying written materials to large dark print will facilitate readability of take home information.

**Conclusions**

Myasthenia gravis (MG) is characterized by muscle weakness, often in the oral area resulting from decreased acetylcholine receptors at the neuromuscular junction. Nerve impulse transmission becomes blocked, resulting in weakness of the voluntary muscles. Dental hygienists must be prepared to make several adjustments in dental hygiene care when working with MG patients to ensure a safe and effective appointment. In particular, they must be alert to symptoms of emergency situations that can arise, particularly myasthenic and cholinergic crisis', which will require 911 assistance and ventilator support. Dental hygienists must also be cognizant of treatment and oral self-care modifications needed due to muscle weakness in the oral pharyngeal area, potential medications that can increase muscle weakness in patients with MG, as
well as medications often prescribed for MG patients that may cause immune suppression resulting in a need for premedication.

Acknowledgements

Notes

Correspondence to: Lynn Tolle, BSDH, MSltolle@odu.edu.

References

Kentucky's Oral Health Wellness and Disease Prevention Program: An Innovative Partnership

Sharlee M Shirley, RDH, MPH

University of Kentucky

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.
The Correlation Between Expanded Career Goals and Internship Courses in BSDH Programs: An Assessment

C Dominick, RDH, MOCEd
Massachusetts College of Pharmacy and Health Sciences

To prepare graduates for leadership roles in the profession of dental hygiene, baccalaureate education is integral. The degree program should not only broaden students' skill base, but importantly, expose them to a variety of career options.

Purpose. To determine if internship placement at alternate sites would impact skill development and future career goals of BSDH-educated dental hygienists.

Method. A longitudinal study was conducted of Bachelor of Science dental hygienists who completed the internship course in the years 2003-2005. Additional data will be collected from the 2006 cohort. A survey was administered to 48 students. There were 21 (N=21) responses. Students were asked to assess the value of internship as a learning experience, a means to acquire new skills, and as an influence on their future career goals.

Results. One hundred percent rated Internship "definitely yes" and "yes" as a valuable learning experience. Students felt they acquired the following skills: Critical Thinking (61.9%), Interpersonal (71.4%), Management (61.9%), Research (57.1%), Public Speaking (52.3%).

Sixty one percent stated that their Internship influenced their future goals: 57.1% plan to further their education in such areas as education, public health, nutrition, and dental school; thirty-eight percent of the student teachers indicated that they would pursue a career in dental hygiene education. When asked, they indicated "observation of student teachers" and "influence of a mentor and a possible career option" as having the most impact on this decision.

Conclusion. It is apparent to date that students benefit from exposure to mentorship in a variety of employment venues. It is anticipated that the additional data will support that the pursuit of alternate practice settings and additional education is directly correlated to the variety of internship experiences.
ADHA's Focus on Advancing the Profession: Minnesota's Dental Hygiene Response

A Monson, RDH, MS and L Engeswick, RDH, MS

The number of dental hygiene schools offering a bachelor degree is decreasing, while the number of schools offering an associate degree is increasing. Of the 10 dental hygiene schools in Minnesota, 2 offer baccalaureate degrees and 8 offer associate degrees. The objectives were: 1) to assess current associate degree dental hygiene students' interest in baccalaureate degree completion and 2) to determine if current interest in curriculum topics supports the ADHA's Focus on Advancing the Profession. A fifty-five-item survey and cover letter were provided to 304 first and second year dental hygiene students enrolled in associate degree programs in Minnesota during Fall 2004, with 204 participating (67% response rate). Survey results were analyzed using descriptive statistical methods.

Results revealed that 66.0% of dental hygiene students were interested in completing their baccalaureate degree. Of those interested, 70.4% would consider, or were strongly interested in, complete online class format, with 5.2% of no opinion and 24.4% uninterested. Only 45.9% indicated interest in classes on campus during traditional day time hours, with 8.9% of no opinion and 45.2% uninterested. Interest levels in 5 of the ADHA focus areas for advancing the profession (research, education, practice & technology, licensure & regulation, and public health) were solicited through 29 items. About 85% of participants ranked advanced practice skills and technology with moderate or high interest, while 30.3% were moderately or highly interested in research.

Existing baccalaureate dental hygiene programs need to support ADHA's Focus Area of Education through leadership in developing models of degree completion to advance the discipline of dental hygiene. Results of this survey demonstrate positive interest in completing the baccalaureate degree, supporting an online format. Incorporating research skills within dental hygiene education is essential to develop one of ADHA's 6 focus areas to increase both confidence and interest levels.
Efficacy of Chlorhexidine-Coated Toothbrush Filaments in Controlling Bacterial Contamination

L Turner, GB McCombs, W Hynes and SL Tolle

Dental Hygiene Research Center, Old Dominion University, Norfolk, VA.

Objective. The purpose of this study was to determine if a significant difference exists in the efficacy of chlorhexidine-coated brush filaments as compared to uncoated filaments in reducing bacterial numbers.

Methods. The IRB-approved, 2-group, double-blind, randomized posttest-only design was conducted with 63 participating adults. After using the control or experimental brush for 30 days, the participants returned the brushes to the researchers in sealed autoclave bags. In the laboratory, microorganisms were detached from the filaments by sonification and vortexing, and then plated on selective media at various dilutions (10-1, 10-3, 10-4, and 10-5). The plates were incubated aerobically for 24 hours at 37° C. After incubation, bacterial colony forming units (CFU) were determined for each sample from 2 different media, one selective (Mitis Salivarius) and the other not (TSA Sheep Blood). Data were analyzed using Wilcoxon and Kruskal-Wallis tests. Fifty-nine samples were returned and processed.

Results. A final sample of 59 toothbrushes were returned and processed. Data from the blood agar indicated the mean number of CFU for the control toothbrush was 3.73 x 10-5 compared to the treatment brush of 3.23 x 10-5. For the Mitis Salivarius agar, the control mean was 2.34 x 10-5 CFU as compared to the treatment mean of 3.07 x 10-5.

Conclusion. Results revealed there was no statistically significant difference in the quantity of bacteria surviving on the toothbrush filaments between the 2 groups after the 30-day trial period; however, findings only reflect the number of aerobic bacterial colony forming units on blood agar or Mitis Salivarius agar. Study results cannot be generalized to include anaerobes or other bacteria, which may react differently to the presence of the antimicrobial agents.
The Adolescent Dental Health Project: Access to Oral Health Care for Low-Income Adolescents

S Camardese

Children's National Medical Center, Washington, DC.

The Adolescent Dental Health Project was collaboratively developed with Dentistry and Adolescent and Young Adult Medicine at Children’s National Medical Center (CNMC) in Washington, DC to address Healthy People 2010, Objective 12-21: “to increase the proportion of low-income children and adolescents who receive any preventive dental services.” This was a pilot project, incorporating descriptive analysis because little information was available about general dentists' office policies and access to care for adolescents. Healthy adolescents cannot access CNMC pediatric dental department services because of age restriction and limitations of size and staff. The purpose of the research was to determine general dentists' office policies for provision of dental services for low-income adolescents in Washington, DC, and any barriers existing for accessing care. Dental professionals' perception of adolescents was also examined.

IRB approval was granted. The stakeholders, adolescents, conducted phone surveys to 100 randomly selected general dental offices in Washington, DC. Data regarding participation with Medicaid, various insurances, sliding scale, and free care were collected. Professionals' perception of adolescents was a subjective assessment by the teens. Data were primary categorical (binary or dichotomous and multicategorical) and analyses including frequencies and bivariate tests of Fisher’s Exact Test were conducted using STATA SE Version 8.0 (2003). Initial interpretation of data revealed 83% of all dental offices were located in the Northwest (NW) quadrant of Washington DC, leading researchers to investigate if there was a bivariate association between financing of care and location. No statistically significant difference was found regarding financial options between NW and other city quadrants. However, one variable, office location, may be the strongest barrier for adolescents to access care. No conclusive evidence regarding professionals' perceptions of adolescents was determined. This research project was funded through an Aetna Foundation community grant.
Assessment of Full-Time Dental Hygiene Faculty Participation in Clinical Practice

J Kiser, RDH, MS, R Wilder, RDH, MS, M George, RDH, MEd and D Fleming, RDH, MS

University of North Carolina at Chapel Hill.

The purpose of this research project was to determine how many U.S. dental hygiene (DH) programs had full-time (FT) faculty members who provided direct patient care in addition to clinical supervision duties. Questions in this project also assessed attitudes and opinions of directors regarding faculty clinical practice and opportunities for salary supplementation. A questionnaire of 20 open and close ended questions was designed on Survey Monkey, an online survey engine. After IRB approval and pilot testing, 278 U.S. DH program directors received two emails requesting their participation in the project, along with a direct link to the questionnaire. A response rate of 69.1% was achieved with 192 program directors responding. Results revealed that 14.2% of the programs required FT DH faculty members to provide direct patient care while 67.0% of the programs had faculties who participated. The primary clinical setting was a private dental practice (90.3%). 83.3% of the programs indicated FT faculty members were compensated for providing direct patient care, and in 95.1% of these programs FT faculties received compensation in addition to their university base salary. 95.4% of directors indicated maintaining clinical skills is an advantage of faculty participation in direct patient care, and 48% of directors indicated participation in direct patient care takes time away from the primary role of an educator. Bivariate analyses were performed in order to acquire correlations using the Chi-square test when both variables being compared were nominal. The Mantel-Haenszel row mean score test was used when a nominal and ordinal variable were being compared. Statistically significant data revealed that respondents from a college / university with a dental school (28%) were more likely to require FT faculties to participate in direct patient care (p-value=0.016). Compared to two-year college respondents (69.3%), respondents from a college / university with a dental school (95.5%) were more likely to agree that faculties should be given the opportunity to provide direct patient care while teaching in DH education (p-value=0.0069). In conclusion, DH faculties are fulfilling their professional development requirement as mandated by the Accreditation Standards for DH Education Programs by participating in direct patient care.
Survey of Oral Health Practices Among Adults in a North Carolina Hispanic Population

M Luciano, RDH, MS, V Overman, RDH, MEd, P Frasier, MSPH, PhD and E Platin, MS, EdD

University of North Carolina.

From 1990 to 2000, the North Carolina Hispanic population increased 394%. This new growth brought challenging health care issues, especially to rural areas areas of North Carolina. The North Carolina Institute of Medicine reported oral health as a major problem for this population. The purpose of this study was to examine oral health, as well as perceived needs, of Hispanics residing in Siler City, NC, a microcosm of the flourishing Latino growth found especially in the southeastern United States. A convenience sample of 158 Hispanic adults was recruited from the largest Siler City Hispanic church. A 41-item Spanish language survey was utilized. Multiple choice questions and Likert-type scales addressed preventive oral health practices, oral health knowledge and beliefs, perceived needs, and demographic information. Frequencies and bivariate analyses were obtained using SAS 9. After excluding 5 surveys, a total of 153 were analyzed. The mean age was 33.8 years, females comprised 54% of the sample, 84% of respondents were of Mexican origin, and the mean time residing in the United States was 8.9 years. The following associations were found statistically significant (p < .05): (1) brushing frequency and belief that healthy gums bleed; (2) dental insurance and frequency of dental visits; (3) individually teaching the participant to brush or floss, participant's reported brushing or flossing, and dental visit frequency. This pilot study provided important baseline information to begin addressing issues related to oral health, and is being used to aid local providers in the implementation of culturally-sensitive public health oral hygiene programs, thereby helping in the elimination of oral health disparities. Findings from this study call attention to the importance of educating the Hispanic population about oral health practices and compliance. Further studies including a random survey and larger sample size may be necessary.
Assessing the Outcomes of Tobacco Cessation Practices by Maryland Dental Hygienists

M Schneiderman, RDH, MS, J Fried, RDH, MS, ME Parker, RDH, MS, PhD, E Romberg, PhD and S Syme, RDH, MS

University of Maryland, Baltimore.

Tobacco use is a significant risk factor for many preventable oral and systemic conditions and diseases. Tobacco cessation intervention has been successful in increasing patient quit rates, thereby improving overall health status. Dental hygienists are the primary providers of preventive oral health care education and services. However, little is known about the tobacco cessation services that hygienists provide and how efficacious their efforts are in reducing tobacco use in the patient population.

This study was designed to assess the outcomes of tobacco cessation services provided by dental hygienists. A systematic random sample of 600 Maryland hygienists was mailed a self-administered 65-item questionnaire that addressed dental Hygienists' knowledge, attitudes, practice behaviors, and perceived barriers that influence their provision of tobacco cessation services. Sixty surveys were returned as undeliverable and 32 respondents did not fulfill employment criteria, producing a response rate of 63% (N = 320). Statistical analyses of the aggregated data included frequencies, t tests, and Pearson's r (p < .001), and were conducted using SPSS software. Significant differences were revealed in both the tobacco cessation services provided and subsequent patient quit rates by hygienists who have received formal education in tobacco cessation as compared to those without formal education. Although the majority of respondents were adequately knowledgeable about the risk factors and current statistics associated with tobacco use, there was no significant relationship between the level of knowledge and the provision of services. A positive relationship, however, was demonstrated between a higher level attitude score and tobacco cessation services provided. Perceived barriers do exist that affect the dental Hygienists' provision of tobacco cessation services. Overcoming perceived barriers to providing tobacco cessation services will enable hygienists to contribute a valuable service for society. Funding for this project was provided through the ADHA Institute for Oral Health.
The dental hygiene program implemented a new clinical evaluation system using formative feedback with periodic summative grading. Formative feedback is provided in narrative form, fostering more open communication while maintaining the same high standard of care. Historically, clinical evaluation was accessed by assigning numeric grades for each patient treated. Faculty believed potential learning experiences were lost when students refrained from asking for feedback fearing points would be deducted from their grade. Currently, students receive formative feedback for the majority of cases and a numeric grade for every second or third case, depending upon patient classification.

Objectives. The objective of the study was to assess student and faculty perceptions regarding the change in the clinical evaluation system.

Methods. A 12-item, 5-point Likert scale questionnaire was administered to dental hygiene seniors (n =23) and clinical faculty (n =13). (Response rate was 88.5% and 100%, respectively.)

Results. One hundred percent of students and faculty consider learning to be more effective in clinic when feedback was provided between graded cases, while fostering a more comfortable learning environment. Ninety-one percent of the students report they were more willing to ask questions when they were receiving formative feedback. Ninety-six percent of the students and 73% of the faculty preferred the new grading system over the previous system, while 100% of both groups feel the change increased communication between faculty and students. Ninety-six percent of the students and 46% of the faculty believe they perform equally on both evaluation types. Only 19% of the students value self reflection while 100% of the faculty believe this helps the student assess the learning experience.

Conclusion. Faculty and students feel equally satisfied with the format, stating that formative cases allow for improved communication and feedback with an increase in cognitive learning opportunities.
The Significance of Dental Hygiene Education in a Dental School Setting

W Moore, RDH, MS, EFDA and S Bauchmoyer, RDH, MA, EFDA

The Ohio State University.

The American Dental Hygienists' Association (ADHA) recently approved the creation of the ADHP and is currently addressing the curriculum. Therefore, it is imperative to maintain dental hygiene program (DHP) affiliations with dental institutions offering advanced degrees in dental hygiene. The trend in dental hygiene education has been the opening of independent programs and the closure of baccalaureate degree programs within colleges of dentistry. Recently, 4DHPs in dental schools have closed. Some closures claimed financial difficulties in maintaining a DHP. There are numerous educational advantages for having a DHP within a dental school for dental and dental hygiene students and the patient. The financial value a DHP generates for a college of dentistry cannot be overlooked as well. Revenues include more than those generated by dental hygiene students, including referrals to pre-doctoral students for other treatment.

Objectives. The objective of this study was to evaluate the financial benefits of a DHP within a dental school.

Methods. An analysis of all dental hygiene procedures completed and fees assessed from June 2003 through December 2004 were obtained and entered into an Excel program. Additional data included completed procedures and fees from referrals to the pre-doctoral students. Data were entered by CDT-4 insurance codes and total revenue was calculated using the Ohio State University College of Dentistry fees during the 2003-2004 fiscal year.

Results. Dental hygiene students produced $184,986 for procedures completed. Six hundred and sixteen patients were referred, producing $142,939. The total income to the College of Dentistry from dental hygiene was $327,925. Dental hygiene clinical expenses during the time period were approximately $158,400.

Conclusions. The DHP at The Ohio State University not only generates income for the college but also provides educational experiences for all students, and will increase the opportunity to accommodate the ADHP curriculum. DHP affiliations with dental institutions facilitate teamwork among aspiring dentists and dental hygienists, while promoting continuity of care for the patient population.
Accurate Calculus Detection: Is it Possible?

Carolyn H Ray, RDH, MEd

Texas Woman's University, Department of Dental Hygiene.

An important goal of dental hygiene education is graduating clinically competent practitioners. Much of the clinical curriculum includes process and product evaluations that monitor and assess dental hygiene students' clinical abilities, especially related to the detection and removal of subgingival calculus. The purpose of this study was to determine if dental hygiene faculty were consistent in detecting "clickable" subgingival calculus that remained after the administration of a mock clinical board (MCB). A MCB was administered to 24 dental hygiene students during their last semester before graduation. The patient criteria for the MCB matched that of the regional board, including: a quadrant with at least 6 natural teeth, including one permanent molar with a proximal contact; a minimum of 12 surfaces with heavy, subgingival calculus; a maximum of 6 deposits on anterior teeth; and no gross decay, probing depths greater than 6 mm, or other dental conditions that would interfere with calculus detection or removal. Five dental hygiene faculty members were assigned with 3 faculty in the morning MCB and three in the afternoon. The faculty members were required to attend an orientation to calibrate the procedures used during the MCB. One faculty member was assigned as a "chief examiner" for each of the 3 sections of the clinic, with 4 dental hygiene students taking the MCB. The "chief examiner" recorded the 12 areas that were evaluated for calculus upon completion of the MCB. Students were not privy to the areas being examined. Upon completion of the procedures, each patient was examined by 3 examiners. The faculty members did not have access to the other instructors' evaluations. The 12 specified areas were examined with an 11/12 ODU explorer, and any surface that exhibited "clickable" calculus was recorded. The results were tallied to track the surfaces marked by each examiner. Two hundred eighty-eight surfaces were examined. There was total agreement of the 3 examiners on 69.8% (n=201) of areas where no calculus remained and 4.6% (n=4) where calculus remained. There were 30.2% (n=87) surfaces that were marked by 1, 2, or 3 for having "clickable" calculus. Two examiners agreed on 33.3% (n=29) surfaces with remaining calculus, while 62.2% (n=54) surfaces were marked by only one examiner. In conclusion, there seems to be more agreement on areas with no detectable deposits. Total agreement was less likely on surfaces that were evaluated as having calculus remaining. More research needs to be done to determine accurate calibration methods for clinical dental hygiene faculty. The findings presented here suggest that subgingival calculus detection may be more subjective than dental hygiene educators realize and calibration is essential.
Preliminary Findings of Consumer-Patients' Perception of Dental Hygienists' Scope of Practice/Qualifications and the Level of Care Being Rendered

Casey Hein, BSDH, MBA, Barbara Kunselman, RDH, MS and Patricia Frese, RDH, MEd

Casey Hein, BSDH, MBA, is a clinical consultant; Barbara Kunselman, RDH, MS, and Patricia Frese, RDH, MEd, are professors at Raymond Walters College, University of Cincinnati.

Dental hygienists perform a wide variety of procedures and there are various levels of care being rendered within the dental hygiene profession, ranging from assembly line prophylaxes to highly technical, nonsurgical periodontal and cosmetic procedures. Consequently, consumer-patients' perception of the scope of practice of dental hygienists, dental hygienists' qualifications, and their level of education may be misunderstood and/or underestimated. There may also be a variance in the kinds of procedures and levels of care delivered by dental hygienists. The purpose of this preliminary, descriptive study was to determine whether 1) there is a significant discrepancy in the majority of consumer-patients' perception of the dental hygienist's scope of practice and educational qualifications; 2) consumer-patients are being screened for oral cancer; 3) incidence of diagnosed periodontal disease approximates well supported epidemiologic trends; and 4) there is a discrepancy in the level of care consumer-patients are currently receiving and the level of care they most value. Three hundred seventy-eight students from 13 schools of dental hygiene utilized a 16-item questionnaire to survey a random sample of 1505 adult consumer-patients in Florida, Illinois, Massachusetts, North Carolina, Nebraska, New York, Ohio, Pennsylvania, South Carolina, and Wisconsin. A preliminary summary of the data indicated there was not a discrepancy in the majority of respondents' perception of dental hygienists' scope of practice and educational qualifications; that over 50% of survey respondents do not recall being screened for oral cancer, periodontal disease was underdiagnosed; and there is preliminary evidence that there may be a discrepancy in the care these consumer-patients received and the level of care they most value. These findings are only preliminary in nature. However, it may be concluded that a larger scale, randomized survey, inclusive of culturally diverse samples throughout the entire United States, may provide valuable information on the quality of dental hygiene care, and perhaps yield evidence of treatment gaps.
New Allied Restorative Functions Training in Minnesota: A Case Study

B Cooper

Objectives. In 2004, the Minnesota Dental Practice Act was modified to allow dental hygienists and dental assistants to place amalgam, composite, glass ionomer, and stainless steel crowns. A continuing education course was offered to provide required certification for interested dental practitioners. The objectives were: 1) to examine confidence levels of participants and 2) to examine effectiveness of the continuing education program offered.

Methods. A 100-point multiple choice pre-test and post-test exam was used to measure restorative content knowledge. A descriptive survey consisting of 18 items was administered to participants (N=12) in a restorative functions course both prior to (day one) and upon completion of the course (8 days later). Using a 5-point Likert scale, participants indicated their perceived level of confidence in 6 restorative knowledge categories and 9 technical skill categories. Additionally, participants were questioned in their ability to learn these techniques and implement them into private practice.

Results. Exam scores analyzed with a matched pairs t-test found a significant increase in participants' restorative content knowledge (p<.01). Wilcoxon signed rank tests revealed an increase in confidence in all content knowledge categories (p<.01) and technical skill categories (p<.05). Participants did not significantly increase in confidence regarding the ability to implement restorative functions skills into practice (p<.7). Interview data revealed participants remain unclear about ways to incorporate these new duties into the practice schedule.

Conclusion. As anticipated, findings in this case study suggest content knowledge and confidence levels of participants increase following completion of a restorative functions course. Research is needed to identify why participants did not increase in confidence related to implementing restorative skills into their daily schedule. Education regarding concepts of how to incorporate restorative functions by allied professionals into practice may improve participant confidence and implementation.
College of Dentistry or Private Practice: A Patient Survey

Julie Carnes, Michele P Carr, RDH, MA and Patricia H Gardner, MA

The Ohio State University

Colleges of Dentistry (COD) and Dental Hygiene Programs (DHP) rely on patients to help educate students and graduate competent dental professionals. In this era of competition for patients, consumer awareness, and customer satisfaction, COD/DHPs must understand and cater to the needs of consumers to attract more patients and retain its existing patient population. It is important to understand why consumers choose a COD/DHP versus private practice and capitalize on these features.

Objectives. The objectives of this study are to evaluate reasons why patients chose a COD/DHP and to assess patient satisfaction with their services.

Methods. Patients at The Ohio State University COD, scheduled with first and second year dental hygiene students, were randomly selected to complete a survey regarding why they chose the COD/DHP and to rate their experiences via a 5-point Likert scale.

Results. Forty-seven subjects completed the survey (24 male, 23 female; mean age 49.5 yrs.). Fifty-five percent of subjects chose the COD/DHP due to cost of dental treatment, and 21% thought their care would be more thorough and would receive better treatment than in private practice. Subjects stated they received good to excellent care, and 99% would recommend the COD/DHP for oral healthcare needs. One-way ANOVA showed no significant difference in the level of satisfaction between males and females and Spearman’s Correlation showed moderate correlation (r=0.263) between age and satisfaction, but no correlation between educational level and satisfaction.

Conclusions. The majority of patients attended the COD/DHP for financial reasons and perception of better care. Subjects surveyed were very satisfied with their experience at the COD/DHP. Satisfied patients are more likely to be compliant with their oral health, use services of the COD/DHP on a regular basis, and are a source of referrals.

This project was supported by The Ohio State University COD Summer Student Research Program.
Changing Attitudes About Elementary School Dental Health Education: A Pilot Study

C Stegeman, RDH, MEd, RD, CDE

University of Cincinnati

The American Association of Dental Schools requires dental hygiene (DH) programs to graduate students who meet entry-level health competency in promotion and disease prevention and community involvement. Competencies include promotion of the values of oral health to the public and organizations within and outside the profession. Gaining a better understanding of the attitudes of first-year DH students toward oral health presentations in the community will aid DH educators in establish teaching strategies to formulate positive attitudes of students. Grounded in the theoretical framework of Bandura (1977), this research has been conducted to determine teaching strategies that strengthen self-efficacy in order to promote a perceived value of DH students in providing health education to the community. The purpose of this study was to measure changes in attitudes of DH students toward providing a dental health presentation to elementary school students after a 10-week undergraduate course in health education. The teaching strategies include lecture, online and class discussion, demonstration and activities, small group assignments, presentation to peers, and written and verbal reflection. An 8 question pre-survey and post-survey was distributed to a convenience sample of 30 female first-year DH students. The pre-survey indicated that 100% of the students felt that there was a need for dental professionals to provide oral health education in the schools, while 67% were somewhat likely to do a dental health presentation once working independently. In addition, this will be the first presentation in front of an elementary classroom for 77% of the students, and 73% were somewhat anxious about presenting. Comments obtained during online and class discussion indicated an increased self-efficacy toward providing oral health presentations.
Dental Hygiene Students Assisting in Workforce Issues

F Miller, CDA, RDH, MSEd, D Summers, DMD and C Lautar, RDH, PhD

Southern Illinois University Carbondale

The purpose of this program is to involve dental hygiene (DH) students in school-based oral health programs under the general supervision of a dentist. Third and fourth-year baccalaureate DH students have participated in the Dental Sealant Grant Program (DSGP). Presently, fourth-year students are assigned to the DSGP as part of a Rural Health course; thus, providing them with a practical service-learning opportunity, and filling a gap in the present workforce to meet the oral health needs within several rural communities. The program has had a history of providing preventive oral health services to the community; however, past problems encountered were restrictive supervision laws and difficulty obtaining dental personnel including licensed dental hygienists and dentists. DH students provide sealants and oral hygiene education to children eligible for free/reduced lunch and/or Medicaid. Previous to the signing of general supervision (GS) into law in August 2004, the DH students had been supervised by licensed DH faculty, including a supervising dentist, leading to an increase in manpower, hours of operation, and production. Prior to general supervision, the DSGP recorded 319 exams and 738 sealants within a 4-year timeframe (spring 2001 through summer 2004). Data represents 7, 16-week (N=112) semesters that averaged 40 exams and 92 sealants. However, after GS, the DSGP recorded 307 exams and 617 sealants in a shorter time period (fall 2004 to spring 2005) for 2, 16-week semesters (N=32) that averaged 153 exams and 309 sealants. Although the DSGP has been a part of the DH program’s community outreach to school sites and church-sponsored summer lunch initiatives, it is only in its second year as a course rotation site. Further evaluation of the DH students’ learning experiences and an analysis of caries experiences among grade school children will become integral components of this program.
Dental Hygiene Students' Perception of Children's Access to Dental Care

WG Barnes, RDH, PhD, A Gancarz-Gojgini, CDA, RDH, MEd, C Phillips, DDS, MS, MCPHS, J Arruda, RDH, MPH and J Neely, RDH, MS

Barnes WG, RDH, PhD; Gancarz-Gojgini A, CDA, RDH, MEd; and Phillips C, DDS, MS, are professors at MCPHS/Forsyth Dental Hygiene Program. Arruda J, RDH, MPH, is a dental hygienist at Boston University, Goldman School of Dental Medicine. Neely J, RDH, MS, is an instructor at Howard University College of Dentistry.

According to a recent study, children lose more than 40 million hours of school each year because of dental pain and dental related illness. Children from lower socioeconomic backgrounds suffer 12 times more "restricted activity days" than children from wealthier families. The most common chronic childhood disease is dental caries, which is 5 times more common than hay fever. To determine the senior dental hygiene students' perception of access to dental care for children, a survey was administered at the end of the Community Health course, spring semester 2005 (n=27, 100% response rate). The survey of 33 quantitative questions (5-point Likert-type scale) was downloaded on the course's Blackboard site in the Assessment section. The mean for each question was automatically calculated by Blackboard. Ninety-four percent of the students expressed that access to dental care was a problem in the United States. Furthermore, even with 3 local dental schools, 94% of the students felt that access to dental care was a local problem. When students were asked their perception of the likelihood that a child would be taken to a dentist if s/he "broke a tooth," 49% reported that the child would "most probably" seek dental care. Forty-six percent responded that they thought the child would "probably" seek dental care. Conversely, 3% reported that they were "not certain" if the child would seek dental care. When asked their perception of the likelihood that a child would seek dental care for a toothache, only 29% indicated "most probably." However, 63% indicated the child would "probably" seek dental care. Seven percent of the students indicated that they were "not certain" if a child would seek dental care for a toothache.

The survey results suggest that the majority of the students perceived that access to dental care was a problem in the United States and locally. Additionally, the students were certain that children would receive palliative care for dental ailments. Future studies would be encouraged to determine the students' perceptions of the basis and solutions to the access to dental care dilemma.
One of the oral health goals of Healthy People 2010 is to improve access to services. The Surgeon General’s Report on Oral Health (May 2000) charge to dental professionals is to "continue to seek solutions to questions of access and barriers to care." To that end, the Advanced Dental Hygiene Practitioner (ADHP) was proposed by the American Dental Hygienists’ Association (ADHA) to provide diagnostic, therapeutic, preventive, and restorative services to the population that is not presently served. This study was developed to ascertain hygiene students’ perceptions of the need for the ADHP. To determine the senior dental hygiene students’ perception of the need for the ADHP, a survey was developed and administered at the end of the Community Health course spring semester 2005 (n=27; 100% response rate). A field test of the survey was conducted by the faculty and their suggestions were incorporated into the survey. The researchers developed 10 quantitative questions (5-point Likert-type scale) and qualitative open-ended questions to help with interpretation of the quantitative results ("please explain your response"). The survey was downloaded on the course’s Blackboard site in the Assessment section. The mean for each question was automatically calculated by Blackboard. The results indicate that senior hygiene students perceive, that to address the disparity of access to dental care, there is an "extreme demand" (47%) for an ADHP. Likewise, 47% of the students felt there was an "average need" for the ADHP. Only 5% of the students felt there was "no need" for an ADHP.

The results of this study indicate that senior dental hygiene students are in agreement with ADHA, and recently published reports, which indicate that access to dental care can be enhanced with the development of the ADHP. Future research is necessary to determine the number of dental hygiene students and practitioners who are interested in pursuing this career option, with the intent to address the disparity of access to dental care by the "un-served public."
The Role of Education in the Development of Cultural Competency in Dental Hygiene Students.

C Holder-Ballard, RDH, EdD

The University of Tennessee

This study seeks to determine if students who completed the 2-year dental hygiene program at the University of Tennessee Health Science Center developed in the area of cultural competency, as measured by the Cross-Cultural Adaptability Inventory (CCAI). In addition, this study attempts to ascertain if certain socioeconomic factors influence the development of cross-cultural competency. The sample consisted of a cohort of 32 students enrolled from 2003-2005. Descriptive statistics, ANOVA procedures, dependent t-test, and independent t-test were calculated to determine results.

The CCAI is a 50-item instrument that determines one's cross-cultural adaptability based on 4 constructs: emotional resilience (ER), flexibility/openness (FO), perceptual acuity (PAC), and personal autonomy (PA). The overall CCAI score is computed from the sum of the 4 dimensional scores. The CCAI pre-test was administered to the dental hygiene cohort at the beginning of the 2-year program, followed by the post-test, which was administered prior to program completion. Results of this study revealed minimal evidence of increase in the overall CCAI post-test score (p = .085). The t tests revealed no significant change between pre-test and post-test scores for 3 of the 4 subscales (ER, PAC, and PA) at the .05 level. However, at the .05 level, the FO scale indicated significant change between the pre-test (M = 65.09, SD = 7.67) and post-test scores (M=67.96, SD = 7.81). Lastly, this study found no significant changes in the CCAI pre-test and post-test scores based on 2 socioeconomic factors, current family status, or parent's educational levels.

The study concluded that the integration of culture-related topics in the educational program is both appropriate and effective. Providing frequent clinical experiences that allow students to interface with diverse populations is an effective strategy for increasing flexibility and openness, one construct of cultural competency.
The Attitudes of Dental Hygiene Students Toward Unverserved populations

M Habibian, H Seiranwan, D Melrose and R Mulligan

University of Southern California, School of Dentistry

Objectives. To evaluate the attitudes of dental hygiene (DH) students toward underserved populations, and to compare their attitudes to the attitudes of freshman dental students (DDS).

Methods. A validated questionnaire designed to measure dental students’ attitudes toward providing care to underserved populations was used. Freshman dental and dental hygiene students at the University of Southern California, School of Dentistry were asked to complete this questionnaire. The study was restricted to female DH students.

Results. The response rate among DH students was 95%; mean age was 25 years; 22% were Asians, and 33% were Caucasians. The mean attitudes scores were not significantly different between the DDS and DH students. However, among Caucasians, DDS students scored more positively by 13% in the student responsibility component of the instrument than did DH students (p<0.01), and they were more likely to believe that access to medical care in America is influenced by type of residence (rural vs. urban) (42% higher; p=0.03). Six percent of the DDS students paid some of their tuition from scholarships compared to 67% of the DH students. Total attitudes scores were 5% more positive among students with scholarship (p=0.04). Fifty-three percent of the DDS students were involved in providing care for the needy before enrolling in dental school compared to 43% of the DH students(p=0.36). Lastly, 82% of the DDS students believed that all population groups should receive free dental care compared to 60% of the DH students (p=0.03).

Conclusions. Significant differences were found between DDS and DH students in terms of their attitudes toward underserved populations, with students who paid some of their tuition from scholarships having more favorable attitudes. Further analysis and studies are needed to determine whether the scholarships themselves, or their eligibility criteria, are behind such an effect.

Keywords: Dental hygiene students, attitude, education, underserved population
New Technology in Dental Hygiene: Facilitating Faculty Acceptance and Adaptation

C Dominick, RDH, MOcEd

Purpose. To detail the steps and obstacles encountered by one dental hygiene program at a 4-year, private, multi-disciplinary institution when transitioning to digital imaging and paperless record keeping. The lessons from this experience can be helpful to other programs contemplating the addition of similar technology.

Method. To determine problems and successes through experiential analysis in the 4 months since first implementing program changes. Dentrix Enterprise software, digital imaging sensors, digital pan, and computers were installed in July; training full-time faculty started August 11 and was to be completed by the start of the semester, August 26, 2006.

Problems. From the start several obstacles were encountered by faculty: resistance to change, anxiety and confusion, lack of familiarity with computer technology, individual learning curves, and diverse interests impeded progress. Faculty training was not completed by the deadline. Training everyone at one time was ineffective. Insufficient lead time was planned for training. As the semester commenced, no one individual had the overall picture of the software program. Uncertainty among faculty led to student error and disorganization as to appropriate record content, and random location of data made retrieval and reference of data by subsequent users difficult. After the first week, the paper record reemerged due to fear of inadequate documentation. This duplicated record entries and extended appointment times.

Solutions. Phase in changes gradually. Small groups and shorter training sessions are more productive. Assign 1 or 2 faculty as "Super Users" with decision-making authority. Allow adequate time for training, assimilation, and reflection. New goals for the program must be established and agreed upon by all participants. Align all revisions in curriculum with program goals. It is essential that the parent institution and its Information Technology Department commit funds and operational support on an on-going basis to the program.

Results. It is hoped that the preceding strategies will facilitate decision making, streamline instruction to faculty and students, and optimize progress toward paperless record keeping.
The Dental Hygiene Degree Completion Program: It's All About Access

Jeanette Siladie, RDH, BS, MEd

St. Petersburg College, St. Petersburg, FL.

The state of Florida has 18 accredited, entry-level dental hygiene associate degree programs, but until now, there was no advanced dental hygiene degree available. As dental hygiene institutions began facing faculty shortages, it became clear that there was a need to provide an opportunity for dental hygienists to earn a bachelor’s degree in dental hygiene. In January 2004, St. Petersburg College (SPC) began offering an online Bachelor of Applied Science in Dental Hygiene (BASDH) degree completion program. Since that time, approximately 70 students have graduated, and 150 students are currently enrolled or are ready to begin. The program seeks to address 3 main issues: ease the impending and current shortages in qualified faculty to staff associate degree programs; provide opportunity to expand career options of the registered dental hygienist outside of traditional clinical practice; aid in the professional development for those in clinical practice. The BASDH program is designed to be accessible to the majority of prospective students. The entire program is delivered online, requires no campus visits, and all web-based course activities are asynchronous. Students enter the program as a cohort and progress through the curriculum together. This fosters a virtual learning community that increases connectivity and team collaboration within the online courses. Courses are offered one at a time in a shortened time frame of 6-8 weeks. The Capstone course provides the opportunity for students to explore their individual area of interest and focus outside the traditional clinical dental hygiene setting, and to do so within their community. The outcomes indicate the mission was met and graduates are being placed in positions that utilize the advanced degree. The online structure of the program creates a stimulating environment that is highly interactive, learner centered, and results in excellent participation and collaboration with peers and instructors.
Development and Implementation of a Web-based BSDH Degree Completion Program

A Gancarz-Gojgini, CDA, RDH, MEd and WG Barnes, RDH, PhD

Massachusetts College of Pharmacy and Health Sciences, Forsyth Dental Hygiene Program.

The purpose of this program is to explore the strategic steps necessary to develop an online Bachelor of Science in Dental Hygiene Degree Completion Program within a 4-year private, multidisciplinary institution to increase the amount of dental hygiene educators in the Northeast region of the United States. The development of the program including benchmark marketing strategies for the target group will be discussed. The process web-based curriculum conversion utilized will be reviewed. The Massachusetts Dental Society and Delta Dental of Massachusetts have recognized a shortage of dental hygiene educators throughout the Northeast. As a result, the Massachusetts Dental Society (#594) and Delta Dental (#556-12) of Massachusetts have both partnered with the Massachusetts College of Pharmacy and Health Sciences to provide financial grant support for this project. As 2-year community college dental hygiene programs continue to offer and produce licensed dental hygienists quickly and inexpensively, the profession has a plethora of Registered Dental Hygienists lacking their bachelor's degree. The conversion of this program seeks to increase the number of baccalaureate-prepared dental hygienists; thus, increasing the amount of dental hygiene educators available to the Northeast states and post-secondary educational settings. Students enrolled in the program will be surveyed regarding their future intentions once they have achieved their bachelor's degree. Upon student completion of the program, students will be surveyed again regarding their employment intentions and opportunities currently available. It is expected that students enrolled in the program will pursue dental hygiene education. Thus, the program should alleviate the shortage of dental hygiene educators in the Northeast region and, as the program becomes more global, increase the amount of dental hygiene educators available throughout the United States.
Dental Hygiene Students' Perceptions of an Academic Service Learning Course on Special Needs Patients

N Keselyak, RDH, MA and M Simmer-Beck, RDH, MS

University of Missouri-Kansas City.

Academic Service Learning (ASL) is a teaching method used to cultivate a connection between course work and real life experiences. It allows students to contribute to their community while meeting explicit learning objectives. In response to the new American Dental Association (ADA) accreditation standard for dental hygiene programs to better prepare professionals to care for people with special health care needs, the didactic portion of a special needs course was revised to include ASL. The purpose of this project was to examine dental hygiene students' perceptions of an ASL course on special needs patients. A retrospective pre-test post-test open response questionnaire, given to a convenience sample of 23 (n=23) female students, was used to determine what students hoped to gain, what they liked best, and what they liked least about the experience. Using the Constant Comparative Method, responses were categorized into recurring themes. Results indicated that students hoped to gain knowledge, understanding, and experience with patients with special needs. After the experience, students generally reported that their expectations were met. Students reported they liked working with people best. Almost half of the students reported a change between their initial thought and what they liked best at the conclusion of the course. Students initially reported the ASL course would be time consuming and felt uncomfortable around patients with special needs. At the conclusion of the course, their main concern was organization at the ASL sites. Most students reported a different concern at the end than they initially reported. The varied list indicated that students were able to observe multiple influences on ASL. In conclusion, course goals were achieved as students reported gaining knowledge and experience in working with patients with special needs.
The Dental Hygiene Department at Farmingdale State University of New York, in collaboration with the Economic Opportunity Commission of Nassau County, developed an innovative oral health education, screening, and service program. The purposes of this program were to increase oral health awareness through education, to identify the need for dental treatment, and to provide access to dental hygiene preventive services for the children in Head Start Programs throughout Nassau County. This unique program utilized existing facilities, faculty, and dental hygiene students to provide a point-of-entry into the oral health care delivery system.

The children arrived at the Dental Hygiene Care Center by bus and were chaperoned by Head Start Staff. A completed health history form and consent form were presented to the faculty. Each child was paired with a dental hygiene student who reviewed the health history, completed an intra oral and extra oral exam, provided oral health education, and performed an oral prophylaxis. Dental hygiene faculty reviewed student findings and the supervising dentist cosigned the screening form. The completed screening forms were returned to the Head Start project coordinator.

This program resulted in the provision of preventive services to 127 Head Start children. The results of the dental screening identified 42 children in need of nonurgent dental treatment and 28 children in need of immediate dental care. Referrals for treatment and follow-up of actual treatment was the responsibility of the Head Start Program.

This collaborative program was initiated in an effort to assess the need and meet the oral health challenge of Nassau County Head Start Children. The services provided helped reduce health disparities and improve oral health outcomes.
Increasing Access to Dental Care Through Primary Health Care Provider Education

B Kennedy, RDH, MA, A Brunick, RDH, MS and W Nilson, MPAS, PA-C

University of South Dakota Department of Dental Hygiene, Physician's Assistant Studie.

Recent research has identified that the historical approach to Early Childhood Caries (ECC) has changed. It is now imperative to screen and treat infants, toddlers, and their mothers to identify those at risk and begin an intervention program during pregnancy and throughout infancy. It is often the primary health care provider, such as physicians, physician's assistants (PA's), nurses, and pediatric specialists who see these young people before they see a dental health care professional. Currently, caries education and prevention is not included in any of these program curricula within the University of South Dakota (USD) other than the dental hygiene program. Like most other states, South Dakota has an access to dental care crisis. The percentages of third graders in South Dakota with a decay history (67%) and untreated decay (30%) are both much higher than the national goals of 42% and 21%, respectively, of Healthy People 2010. The purpose of this educational pilot project is to supply basic knowledge of ECC, fluoride varnish application, and the preventive role of xylitol and chlorhexidine to PA students. Evaluation mechanisms include a pretest and posttest measuring a change in students' knowledge base. An increase in knowledge has been shown. Expansion of the project includes educating USD medical and nursing students, and mentoring and observing these health care providers as they implement these prevention strategies during clinical rotations. It is the goal of this project to increase access to dental care through primary health care providers who will perform oral screenings and implement prevention strategies during well-baby checks, immunization appointments, and prenatal care.
A New Course to Enhance Pre-Clinical Dental Hygiene Learning Experience

B McClure, RDH, BS

The Ohio State University College of Dentistry.

As a result of feedback from students and faculty, a few areas of clinical preparation needing more proficiency were identified. A new program was developed to enhance the preclinical dental hygiene (DH) learning experiences. Traditionally, all preclinical skills were taught in one academic quarter. The new program continued preclinical teaching to the first half of the following quarter. In addition to didactic teaching, individual skill assessments were added so that students could have one-on-one instruction in instrument sharpening, removing calculus, and the use of the ultrasonic scaler. Since the skill assessments were evaluated, students were well prepared, thus allowing the instructors to take the skills to a level of practical application. Senior DH practicum students assigned in the course were responsible for creating dental charting scenarios and helped guide beginning students in completing appropriate paper work. A 4-point Likert survey was given to the 30 DH students, 9 clinical faculty, and 5 practicum students to identify their perception of preparedness for aspects of clinical care. While the majority of students felt prepared in most aspects of clinical care, some interesting information emerged. The majority of practicum students felt the class they helped teach was more prepared than they had been in the areas of instrument sharpening (80%), use of the ultrasonic scalers (80%), and completion of paper work (60%), while the majority of the beginning students did not feel prepared in the use of the ultrasonic scaler (97%) or completion of paper work (87%). Faculty (86%) felt the students were more prepared in these areas than in previous years. It appears that both faculty and practicum students feel that students are more prepared than in the past, but the beginning students still do not feel adequately prepared in all aspects of patient care.
A Program to Help Identify Victims of Domestic Violence

J Gibson-Howell, RDH, BS, MSEd, EdD

The Ohio State University College of Dentistry, Dental Hygiene, Section of Primary Care.

Domestic violence has been coined an “unacknowledged epidemic.” Nearly 5.3 million women, 18 years and older, are victimized by intimate partners each year. It is estimated that 33% of female emergency room visits are due to domestic violence (DV), yet only 10% are identified as victims. Data indicates that lack of information and unwillingness to question patients has contributed to the deficit of identifying DV victims in the health care setting. Although it may be uncomfortable questioning potential victims, it is a professional responsibility of the dental professional (DP). Being trained, having experience, and feeling comfortable while asking questions may support DP to accept this responsibility.

The purpose of these presentations was to inform DP and students about the signs and symptoms of DV so they can comfortably and effectively interact with possible victims. Two programs were presented with the same basic information and pre-assessment and post-assessment questions. The SAFE Question strategy was introduced and opportunities for participants to discuss appropriate questions and discuss referral was provided. A presentation to third year dental students (n=76) in a patient management course and a continuing education course for DP (n= 21) was conducted.

The pre-assessment to dental students revealed that more than 60% did not feel comfortable identifying signs and symptoms, documenting/referring, and conversing with possible victims while the post-assessment indicated that 90% felt they would be comfortable questioning the potential DV victim. The pre-assessment to the DP revealed that more than 47% did not feel comfortable and the post assessment revealed that more than 71% would feel comfortable questioning potentialDV victims. Although there were positive results from the respondents, it is a goal to include more experience in actually asking questions by role playing or utilizing a standardized patient. Working with a pre-recorded audiotape as the interviewer is also a method being investigated.
Adult Tobacco Use by AASU Dental Hygiene Clinic Patients

S Edenfield, EdD, RDH and K Coulton, RDH, BS, MSEd, EdD

Armstrong Atlantic State University.

The purpose of this study was to determine the frequency of tobacco use and interest in cessation by patients utilizing the Armstrong Atlantic State University (AASU) dental hygiene clinic. The study's aim was to contribute to the Southeast Georgia Cancer Coalition goals in its mission to educate the public about tobacco use health risks and to provide cessation education. Subjects were of diverse age, socioeconomic status, and ethnicity groups, including those who were medically compromised and may have limited access to care. A medical history, oral assessment, and tobacco use survey were conducted. Utilizing a National Cancer Institute survey for tobacco use and interest in cessation assessment form, data were analyzed to determine age, race, gender, and quantifiable tobacco use and cessation factors by tobacco users. Of the sample (N= 202), there was a greater number of nonusers and a total of 37 tobacco users. Pearson’s r Linear Association and Spearman Correlation indicated that in the user subgroup, inhalation was the most frequent mode of use; tobacco use by women was significant (p<.03), while use by men was not; whites (12:1) used more than nonwhites; younger individuals (18-33 years) used tobacco at a greater rate; and, the trend to smoke decreased with age. The data further suggested that the younger age group, both males and females, demonstrated higher levels of interest in cessation. Additionally, the younger age group indicated participation in cessation consultation with a physician (p<.05). It was concluded that tobacco use assessment provides the dental hygiene student with an awareness of their integral role as educator, advocate, and clinician, thereby contributing to the patient's overall health, most specifically young white females. It further serves society by assisting in the reduction of a major health risk.