Promotion of Oral Health: Need for Interprofessional Collaboration

Rebecca S Wilder, RDH, BS, MS

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"The Surgeon General's Report on Oral Health in America (US Department of Health and Human Services, 2000) and, more recently, the National Call to Action to Promote Oral Health (US Department of Health and Human Services, 2003) emphasized the need for partnerships of key stake holders to get involved in oral disease prevention. Interventions aimed at promoting healthy outcomes and preventing disease should include a focus on oral health." [1]

You are probably thinking that the excerpt above was extracted from a dental or dental hygiene publication? Maybe it was taken from a dental public health journal? I am pleased to tell you that the entire January/February 2008 issue of *The American Journal of Maternal Child Nursing* (MCN) was devoted to oral health. Among the many valuable and informative articles was the theme that nurses are in an "ideal position to provide health promotion and education and screening across the multitude of settings in which they work regarding oral health and risk factors for oral disease."

Why are nurses an ideal profession in which to collaborate to promote oral health? As written by Clemmens and Kerr[1] in their article titled, "Improving oral health in women: Nurses' call to action," nursing practice entails "promotion and protection of individual and population health and prevention of disease and disability." The practice of nursing involves assessment, planning, teaching, counseling and direct care, and policy and advocacy for target patient groups. Does this

sound familiar? Dental hygienists do much of the same. They also assess, plan, teach, counsel, and provide direct care...as well as provide input into policy and advocacy for patient populations. The authors note that oral health has not been a high nursing priority in the past however they stress that NOW is the time to increase nursing's awareness, knowledge, and skills about the impact of good oral health.

Why is nursing taking such a bold step now? The medical and nursing professions are beginning to read the science in dentistry and realize that there truly is an oral-systemic connection. While we do not know if a causal relationship exists for many of the areas under study (ie, adverse pregnancy outcomes, cardiovascular disease and stroke, diabetes, etc), we have no doubt that optimal oral health can only be beneficial for every person.

There has been little interaction between nursing and dentistry or dental hygiene.[2] In the past, nurses have had little interest in getting involved in oral health issues. A 2001 study reported that nurse practitioners did not think oral health screening was their responsibility and only 35% correctly identified oral disease risk factors. A recent study conducted by Thomas et al at the University of North Carolina surveyed 504 nurse practitioners (NP), physician assistants (PA), and nurse midwives (NMW) regarding knowledge, behaviors and opinions about periodontal disease, and adverse pregnancy outcomes. Two hundred and forty practitioners responded (48%). Sixty-three percent perform an oral health exam at the initial visit only. Only 20% agreed or strongly agreed that their knowledge about periodontal disease is current. All agreed that NP, PA, and NMW should be taught about periodontal disease, and 95% agreed they should collaborate with dental professionals to reduce a patient's risk of having an adverse pregnancy outcome.[3]

However, there is little integration of oral health education in the curricula of nursing programs.[4] And it does not appear that much is being done regarding interprofessional collaboration and education in dental hygiene. For example, a 2007 national study of dental hygiene program directors regarding oral-systemic disease content in their curricula found that 99% of the directors think dental hygienists will serve an important role in the future with assessment of oral-systemic disease. Yet, only 4% have content taught with other professionals such as nursing or allied students.[5]

Dental hygiene must take a lead and reach out to nursing and other health care professionals and collaborate to promote optimal oral care. There are 2.3 million nurses working in the United States. Studies have shown that nursing interventions are effective in promoting heath and preventing disease in the US population. But in order for this to occur, education has to take place. Nurses need to know how to perform oral health evaluation and how to make referrals to dental hygienists and others in the dental profession. Nurses and dental hygienists must not continue to work in silos, each looking at only certain aspects of the body. Why can't dental hygienists play a vital role in tobacco cessation, high blood pressure detection, cholesterol and diabetes screening, determination of risk factors for cardiovascular disease, counseling about nutrition and obesity-all with the intent of making timely referrals to the most appropriate medical or nursing professional.

I think the future is bright for our profession. But we must reach out and collaborate with our medical professionals and teach them about oral health. It sounds like the door is open if we will just begin taking the necessary steps.

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Upfront

Katie Barge

Katie S. Barge is staff editor of the Journal of Dental Hygiene and staff writer for Access

Avocados May Help Prevent Oral Cancer, OSU Study Shows

Nutrients taken from avocados are able to thwart oral cancer cells-killing some and preventing precancerous cells from developing into actual cancers-reported researchers at The Ohio State University in the journal Seminars in Cancer Biology.

Researchers found that extracts from Hass avocados-the most readily available at supermarkets nationwide-kill or stop the growth of precancerous cells that lead to oral cancer.

"As far as we know, this is the first study of avocados and oral cancer," said Steven M. D'Ambrosio, study lead author and a member of the molecular carcinogenesis and chemoprevention program at Ohio State's Comprehensive Cancer Center. "We think these phytochemicals either stop the growth of precancerous cells in the body or they kill the precancerous cells without affecting normal cells."

D'Ambrosio, who collaborated with researchers in Ohio State's College of Pharmacy, found that phytochemicals extracted from avocados target multiple signaling pathways and increase the amount of reactive oxygen within the cells, leading to cell death in precancerous cell lines. But, importantly, the phytochemicals did not harm normal cells.

Avocados are cock-full of beneficial antioxidants and phytonutrients, including vitamin C, folate, vitamin E, fiber, and unsaturated fats. They are naturally sodium-free, contain no trans fats, and are low in saturated fat, making them a health addition to any diet, said D'Ambrosio.

D'Ambrosio also authored an accompanying editorial in Seminars in Cancer Biology entitled "Phytonutrients: A more natural approach toward cancer prevention." "The future is ripe for identifying fruits and vegetables and individual phytonutrients with cancer preventing activity," wrote D'Ambrosio in the editorial. "As we identify the molecular mechanisms and targets by which individual phytonutrients prevent cancer, we may be able to improve upon nature by formulating phytonutrient cocktails for specific cancer and individual susceptibility risk."

According to the researchers, previous research has found an association between the consumption of fruits and vegetables and reduced risk for various types of cancers. This reduced risk is attributed to the high levels of phytonutrients and phytochemicals found in dark colored fruits and vegetables.

"Our study focuses on oral cancer, but the findings might have implications for other types of cancer," said D'Ambrosio. "These are preliminary findings, and more research is needed."

Review of: Quality Matters: From Clinical Care to Customer Service

Kip Rowland, RDH, MS

Reviewed by Kip Rowland, RDH, MS, surgical/hygiene specialist, Brasseler USA.

Quality Matters: From Clinical Care to Customer Service

Rattan R

Quintessence Publishing Co.

Carol Stream, Ill, 2007

168 pages, illustrations, indexed

ISBN: 1-85097-100-5

$54.00

This is a very thorough, technically written book on quality, from abstract definitions and historical models to clinical audits and theories. This book is filled with many illustrations of theoretic models, tables, and charts that support the text. The Clinical Audit chapter was especially interesting to me as it showed how to thoroughly assess quality in a clinical practice to improve it. Quality Matters is a fantastic resource for a dental hygiene or dental educator. It would also be an excellent reference for a research dental hygienist. The practical value to the clinical dental hygienist would be very limited due to the abstract and research-oriented nature of this book.

Review of: General and Oral Pathology for the Dental Hygienist

Frieda A Pickett, RDH, MS

Reviewed by Frieda A. Pickett, RDH, MS, dental hygiene educator, author, lecturer, Butler, Tenn.

General and Oral Pathology for the Dental Hygienist

Delong L and Burkhart NW

Lippincott Williams & Wilkins

Baltimore, Md, 2007

576 pages, softcover

ISBN: 0-78175-546-8

$78.95

This book is intended for dental hygiene students and practitioners. It is a comprehensive study of general pathophysiology and oral pathology in the same text. It teaches the essential information needed to identify elements of disease with associated clinical implications and to visually examine and recognize oral disease in practice.

The General Pathology section covers the major determinants of disease and the body systems as they are assessed when gathering information from the medical history. There are 10 chapters in the general pathology section, including chapters on inflammation and repair, the immune system, neoplasia, hereditary and congenital disorders, cardiovascular diseases, blood diseases, and a chapter combining respiratory, gastrointestinal, neurologic, and skeletal disorders.

The Oral Pathology section is organized according to characteristics of lesions (such as white, pigmented, papillary, ulcerated), so readers can learn to recognize lesions by appearance and differentiate between lesions with similar features. There are 13 chapters in the oral pathology section, including unique chapters such as "Lesions That Look Like Vesicles," "Ulcers and Ulcer-like Lesions," and "Lesions in Shades of Red to Purple." Skin lesions are included in the oral pathology section, as well as oral manifestations of HIV and AIDS.

Each chapter begins with an outline. Learner objectives and key terms are provided at the beginning of each chapter and are bolded and defined within the text. Chapter information is organized according to the common name for the disorder; etiology of the disorder; the method of transmission; epidemiologic information, such as incidence and prevalence of the condition; a brief description of the pathogenesis; extraoral, perioral, and intraoral manifestations, as well as distinguishing characteristics; microscopic features; differential diagnosis for conditions with similar features; patient management implications; and treatment and prognosis. There are several unique features of the text. These include the inclusion of critical thinking activities in each chapter, along with an "Application" section for clinical situations and case studies, which promote understanding of how the information is incorporated into a dental hygiene treatment plan. Each chapter includes suggestions for student-directed projects useful in demonstration of progress toward meeting competencies associated with patient care, health promotion, and disease prevention. Another unique feature of the text is a section on Clinical Protocols at the back of the text. The protocols are written by experts in the field of dentistry and dental education.

References to these clinical protocols are included within each chapter to direct the reader to current management strategies. The text includes more than 400 detailed color photographs and illustrations to help identify pertinent characteristics of conditions. Distinctive clinical features of lesions are accompanied by lists of associated diseases. There is an internet-based Student Resource Center from which students can access review questions and answers, along with rationales. Additional case studies associated with each chapter can be accessed at the Web site http://thePoint.lww.com/Delong. An instructor resource center is provided with an image bank, additional case studies to use for quizzes, tests or classroom discussion, and an instructor test bank.

This text provides a much needed collection of information for both general pathology and oral pathology. There are some photographs in the text that are upside down, but this can be easily corrected in reprinted editions. The quality of some radiographs is poor, but most illustrate the specific feature very well.

Review of: Contemporary Periodontal Surgery: An Illustrated Guide to the Art Behind the Science

Patricia A Frese, RDH, MEd

Reviewed by Patricia A. Frese, RDH, MEd, professor, University of Cincinnati, Raymond Walters College, Department of Dental Hygiene, Cincinnati, Ohio.

Contemporary Periodontal Surgery: An Illustrated Guide to the Art Behind the Science

Bateman G, Saha S, Chapple I

Quintessence Publishing

London, 2007

204 pages, 283 images, indexed, hardcover

ISBN: 1-85097-123-4

$54.00

Contemporary Periodontal Surgery concludes the periodontal volumes in the QuintEssential series written for general dental practitioners. The series covers the basic principles and key concepts of 9 topics such as pediatric dentistry, radiography, and practice management in addition to periodontology. Each volume is written to be read alone or in conjunction with other volumes in the series. This volume, like the others, is easy to read, enjoyable, and illustrated with striking photographs, clear diagrams, appropriate radiographs, and supportive tables. It contains 11 chapters on topics including case selection, planning, and surgical principles and techniques. Each chapter generally contains a statement of purpose, the intended outcome, an introduction, the main content, references, and suggestions for further reading.

This text is similar to a 'how-to' of periodontal surgeries from case selection to postsurgical care. The focus is not on the etiology of periodontal diseases but rather on the multitude of decisions to be contemplated before choosing surgical intervention; performing complete surgical planning; and delineating patient and practitioner responsibility for positive surgical outcomes.

This volume accomplishes its goal of educating the dental practitioner in patient selection and education, outlining a stepwise approach to the execution of various surgeries, providing tips for patient comfort, and explaining techniques to minimize unforeseen events. The text is not intended to provide periodontal debridement techniques for the practicing dental hygienist. However, chapter one contains limited information helpful to the dental hygienist regarding selection of patients who would benefit from periodontal surgery, record keeping suggestions, postoperative instructions, and return visits.

Therefore, the dental hygienist should enjoy this text as a review and update of periodontal surgical procedures, a source of information and photographs for patient education about such procedures, and a foundation for a better understanding and appreciation for the art and science of periodontal surgery, not as a resource for dental hygiene care of the periodontally-involved patient.

Systematic Review Exemplar: Preventing Mucositis in Cancer Patients

Karen B Williams, RDH, PhD

Karen B. Williams, RDH, PhD, 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 BS in education at The Ohio State University, her MS in dental hygiene education at the University of Missouri-Kansas City, and PhD in evaluation, measurement and statistics at the University of Kansas. Dr. Williams has been active in clinical dental hygiene for over 35 years and in clinical research for 23 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health outcomes research, 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.

Interventions for preventing oral mucositis for patients with cancer receiving treatment Volume (4), 2007.

Worthington, HV; Clarkson, JE; Eden, OB. Cochrane Oral Health Group

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Abstract

Background. Treatment of cancer is increasingly more effective but is associated with short and long term side effects. Oral side effects remain a major source of illness despite the use of a variety of agents to prevent them. One of these side effects is oral mucositis (mouth ulcers).

Objectives. To evaluate the effectiveness of prophylactic agents for oral mucositis in patients with cancer receiving treatment, compared with other potentially active interventions, placebo or no treatment.

Search Strategy. The Cochrane Oral Health Group Trials Register, the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and EMBASE were searched. Reference lists from relevant articles were scanned and the authors of eligible studies were contacted to identify trials and obtain additional information. Date of most recent searches: June 2006: CENTRAL (*The Cochrane Library* 2006, Issue 2).

Selection Criteria. Trials were selected if they met the following criteria: design - random allocation of participants; participants - anyone with cancer receiving chemotherapy or radiotherapy treatment for cancer; interventions - agents prescribed to prevent oral mucositis; outcomes - prevention of mucositis, pain, amount of analgesia, dysphagia, systemic infection, length of hospitalisation, cost and patient quality of life.

Data Collection and Analysis. Information regarding methods, participants, interventions and outcome measures and results were independently extracted, in duplicate, by two review authors. Authors were contacted for details of randomisation and withdrawals and a quality assessment was carried out. The Cochrane Collaboration statistical guidelines were followed and risk ratios (RR) calculated using random-effects models.

Main Results. Two hundred and seventy-seven studies were eligible. One hundred and eighty-eight were excluded for various reasons, usually as there was no useable information on mucositis. Of the 89 useable studies all had data for mucositis comprising 7523 randomised patients. Interventions evaluated were: acyclovir, allopurinol mouthrinse, aloe vera, antibiotic pastille or paste, benzydamine, beta carotene, calcium phosphate, camomile, Chinese medicine, chlorhexidine, etoposide, folinic acid, glutamine, granulocyte/macrophage colony-stimulating factor (GM-CSF), histamine gel, honey, hydrolytic enzymes, ice chips, iseganan, keratinocyte GF, misonidazole, pilocarpine, pentoxifylline, povidone, prednisone, propantheline anticholinergic, prostaglandin, sucralfate, systemic antibiotic clarithromycin, traumeel, zinc sulphate. Of the 33 interventions included in trials, 12 showed some evidence of a benefit (albeit sometimes weak) for either preventing or reducing the severity of mucositis. Interventions where there was more than one trial in the meta-analysis finding a significant difference when compared with a placebo or no treatment were:

- Amifostine which provided minimal benefit in preventing mild and moderate mucositis RRs = 0.95 (95% confidence interval (CI) 0.92 to 0.98) and 0.88 (95% CI 0.80 to 0.98);

- Chinese medicine showed a benefit at all three dichotomies of mucositis with RR values of 0.44 (95% CI 0.20 to 0.96), 0.44 (95% CI 0.33 to 0.59) and 0.16 (95% CI 0.07 to 0.35) for increasing levels of mucositis severity;

- Hydrolytic enzymes reduced moderate and severe mucositis with RRs = 0.52 (95% CI 0.36 to 0.74) and 0.17 (95% CI 0.06 to 0.52); and

- Ice chips prevented mucositis at all levels RRs = 0.64 (95% CI 0.50 to 0.82), 0.38 (95% CI 0.23 to 0.62), and 0.24 (95% CI 0.12 to 0.48).

Other interventions showing some benefit with only one study were: benzydamine, calcium phosphate, etoposide bolus, honey, iseganan, oral care, zinc sulphate.

The general reporting of RCTs, especially concealment of randomisation, was poor. However, the assessments of the quality of the randomisation improved when the authors provided additional information.

Authors' Conclusions. Several of the interventions were found to have some benefit at preventing or reducing the severity of mucositis associated with cancer treatment. The strength of the evidence was variable and implications for practice include consideration that benefits may be specific for certain cancer types and treatment. There is a need for well designed and conducted trials with sufficient numbers of participants to perform subgroup analyses by type of disease and chemotherapeutic agent.

Commentary

In the past several years, the dental hygiene community has increasingly focused on the importance of evidence-based decision making for improving oral health outcomes in our patient populations. Concomitantly, the scientific community has raised concern about the inherent problem of "publication bias." Publication bias occurs when editorial review boards and journal publishers preferentially publish clinical trials that have significant findings. As a result, studies demonstrating no effect for treatments and interventions are rarely published. Publication bias in an evidence-based world gives a skewed view of the real effect of treatments and can lead clinicians to make inappropriate treatment decisions. In the early 1990's, the Cochrane Collaboration was started with the goal of providing access to "accurate information about the effects of healthcare world wide." The Cochrane Collaboration produces, and makes available, systematic reviews on a variety of health care intervention topics, including oral health. A systematic review is a methodologically sound approach to comprehensively compiling and analyzing all literature on a given topic. It starts with a research question that provides

the focus for planning a search strategy, selecting studies that represent only the highest level of evidence on the topic, and subsequently summarizing the "state of knowledge" based on this best estimate. The systematic review overcomes many of the problems inherent in conducting a literature review in that selection bias, sampling bias, and quality control bias is intentionally controlled. Selection bias is addressed by specifying a very inclusive search strategy for obtaining related studies. The search strategy often includes identification of all search engines that might yield relevant studies, papers presented at meetings, and/or contacting leading researchers in the field to ferret out existence of unpublished data. Studies are selected regardless of language or country of origin, and once the search has identified all possible studies, quality is assured by analyzing studies methodology and choosing for inclusion only those studies that meet rigorous standards of quality. This systematic review is a good example of a systematic review, and was focused on evaluating the effectiveness of various prophylactic agents for preventing or reducing severity of oral mucositis in patients receiving cancer treatment. Overall, it clearly demonstrates that there is no simple means by which mucositis can be prevented nor one-step approach to managing mucositis in cancer patients. Additionally, it shows that certain interventions may be more effective for certain cancer treatments than others.

Treatments for cancer (in particular chemotherapy or radiotherapy) have increased survival rates in patients, but the short-term effects on the mouth, especially with respect to severe mucositis or oral candidiasis, can predispose individuals to pain, difficulty eating, bacteremia, and interruption of cancer treatment. This presents a significant challenge to the oncology team as well as the oral health professionals to know best practice standards that will prevent development of mucositis or candidiasis, or at the very least minimize the severity of these problems Numerous interventions have been examined and include palliative surface protectants as well as treatments that possess anti-inflammatory and antimicrobial properties. Additionally, studies have assessed numerous outcomes including pain, duration and severity of difficulty eating, infection, delay of treatment, toxicity, quality of life, weight loss, and death.

In this review, the research team was particularly interested in comparing active mucositis preventing interventions with placebo treatments or no treatment as a means to determine the incremental effectiveness of the active treatments. Consistent with systematic review methods, the researchers clearly defined: the types of studies that would be included in their analysis (only randomized clinical trials); what target population studies had to address (patients with cancer receiving chemotherapy or radiotherapy or both); treatments that were intended to have a prophylactic effect for oral mucositis and that were compared to a placebo or no treatment; and studies that had mucositis as a primary outcome. Several other secondary outcomes were evaluated as well, but the primary emphasis was on preventing mucositis. Where there were questions regarding methodology of any of the studies, the researchers attempted to contact the original authors to clarify needed information.

The review team made an effort to use a search strategy that effectively included as many research studies as possible, whether they were available from electronic searching (eg, published in professional journals, in clinical trials registers, available from various search engines, etc.), were currently being conducted by researchers in the field, or had been presented at meetings but not published. The research team independently conducted a quality assessment of each article included in the review to ensure that it met sufficient quality standards for inclusion. They reported excellent agreement between reviewers with regard to rating quality of studies for inclusion.

Of the 227 studies that were initially identified in the search process, the researchers determined that 188 of these had critical design or measurement problems that kept them from meeting the rigorous standards for inclusion. Of the remaining 89 studies that did meet these standards, 24 studies were conducted in the United States, 30 were conducted in Europe, and the remaining 35 were performed in 13 different countries. Thus, the studies included in this systematic review provided data from a highly diverse and global population of both adult and pediatric cancer patients. The interventions evaluated were diverse as well and included a variety of medications (acyclovir, amifostine, antibiotics, chlorhexidine, etoposide, pilocarpine), enzymes (allopurinol), anti-inflammatory medications (benzydamine, calcium phosphate), acid buffers (sulcrafate), and natural treatments (beta carotene, aloe vera, chamomile, honey, ice chips, oral hygiene, and Chinese medicine), just to name a few.

There was sufficient evidence to support that some of the treatments were effective in reducing or preventing oral mucositis. Amifostine had some of the best evidence with 11 clinical trials (that included a total of 845 subjects) having a reduction in risk for mucositis compared to placebo or no treatment. Oral proteolytic enzymes also showed fairly strong evidence for reducing severity rather than preventing oral mucositis. Inflammatory mediators, benzydamine and calcium phosphate,

were also was found to be significantly more effective than a placebo for preventing mucositis, but both were based on findings from single studies of 36 and 94 patients, respectively.

Of the natural treatments, there was no evidence that aloe vera, beta carotene or chamomile were effective in preventing mucositis, although these products are commonly used as palliative agents to improve patient comfort. However, there was weak evidence that Chinese medicine, comprised of various unidentified herbal concoctions, could reduce the risk for mucositis, and that honey could reduce prevalence of severe mucositis. However, the researchers caution that the strength of this evidence was relatively unreliable, and the herbs used in the Chinese medicine were not specified. Certainly one cannot generalize from this that Chinese medicine on the whole is effective. However, there was relatively good evidence that ice chips may prevent or reduce the severity of mucositis primarily in patients receiving 5-FU as part of their chemotherapy regimen. Additionally, good oral hygiene was found in a single study, to have some preventive benefits in individuals receiving head and neck radiotherapy.

Of interest, trials investigating the effectiveness of topical antimicrobials (9 studies in all) such as chlorhexidine and providone, did not show a consistent effect for preventing mucositis in cancer patients. It is important to note that the researchers state that there was insufficient evidence to substantiate effectiveness, not that there was evidence to show no effect, an important distinction.

This systematic review provides important information for dental hygiene clinicians. Knowing the state of evidence on topics related to oral health allows the dental hygienist to provide more accurate and scientifically relevant information to patients. Cancer patients having treatments that can disrupt the integrity of the oral mucosa need to know that there are options available for them to discuss with their oncologist. Additionally, the dental hygienist is a primary source for information on maintaining optimal home care procedures during cancer treatment.

The Bottom Line

Recent statistics estimate that approximately 1 400 000 people in the United States will be diagnosed with cancer each year. While this number is daunting, the trend in 5-year survival rates for all races gives a reason for optimism. Improvements in cancer treatments have increased 5-year survival rates from 51% in the mid 1970s to approximately 65%, currently. Certainly dental hygienists play an important role in helping identify the 60 000 new cases of oral cancer; however, they play another important role in providing preventive counseling for patients receiving chemotherapy or radiotherapy to the head and neck region. The sheer volume of literature on effectiveness of various interventions for preventing or reducing oral mucositis in this large population makes it virtually impossible for dental hygienists to remain abreast of the most current information. This systematic review, undertaken by the Cochrane Collaboration, provides an analysis of best evidence on treatments that either prevent or reduce severity of mucositis. Knowing that success of mucositis prevention varies depending on cancer therapy will encourage dental hygienists to empower patients to have meaningful conversations with their oncologists about mucositis prevention. Several findings from this review provide guidance for best practices in dental hygiene. Certainly, the evidence that good oral hygiene can be effective in preventing mucositis in individuals having radiotherapy supports the need for effective preventive education for our patients with head and neck cancers. This should be a standard practice irrespective of cancer therapy. Moreover, dental hygienists must be knowledgeable about effectiveness as well as limitations of various treatments. Individuals with mucositis from chemotherapy and radiotherapy are often desperate for relief, making them susceptible to product claims that may not be supported with clinical evidence. The dental team plays an important role in providing sound advice based on scientific, not anecdotal, evidence.

Dental hygienists who possess knowledge about simple natural treatments that are helpful in preventing or reducing severity of mucositis (ice chips for individuals receiving 5 FU as part of their chemotherapy regimen or uncontaminated honey for reducing severity of mucositis) can encourage patients to discuss options with their oncologists. Just as well, they need to know that common treatments such as aloe vera, chamomile, beta carotene, or sucralfate do not have sufficient scientific evidence as effective interventions to recommend these to cancer patients for preventing or reducing mucositis. While they may have a palliative role for improving patient comfort, this should not be confused with being effective treatments for mucositis. Additionally, the dental hygienist can play an important role in helping establish best practices in the dental office by developing guidelines for cancer patients as to how to have meaningful conversations with the oncology team about mucositis prevention.

The researchers who conducted this systematic review for the Cochrane Collaboration comprehensively and meticulously analyzed the 89 best studies in order to determine what is the best evidence on treatments that prevent or reduce severity of oral mucositis for patients receiving chemotherapy or head and neck radiotherapy. Systematic reviews are an important source for scientific evidence in that they provide an objective and global overview of the strength of scientific evidence for various health interventions and outcomes. The Cochrane Collaboration Oral Health Group has produced more than 50 systematic reviews on topics broadly defined as prevention, treatment, and rehabilitation of oral, dental, and craniofacial diseases and disorders. Topics of interest to dental hygienists range from managing oral complications of cancer treatment, fluoride for caries, behavioral interventions to improve patient outcomes in periodontal patients, pit and fissure sealants versus fluoride varnish for preventing dental caries, etc. (http://www.ohg.cochrane.org/reviews.html#reviews)

Summary

The sheer volume of literature on topics relevant to dental hygienists can make it difficult to provide patients with best professional advice. Systematic reviews offer a means by which dental hygienists can access best evidence and utilize it in their day-to-day practices. This systematic review provides an example of how a large body of seemingly diverse studies can be distilled into usable information that can inform practice standards. Dental hygiene clinicians will inevitably be in a position to provide counseling to cancer patients or their family members on preventing or reducing the severity of mucositis. The large body of literature and numerous interventions that have been proposed for mucositis makes it difficult for the average clinician to know what treatments yield the best outcomes. This systematic review is a rich source of information as the researchers have methodologically searched, dissected, analyzed, and distilled the most important findings from a wide body of evidence. While there are numerous treatments available for mucositis, only a few have sufficient scientific evidence at this point to make solid recommendations to patients. Clinicians need to counsel their patients to discuss options with the oncology team in advance of therapy in order to limit negative effects on the oral cavity. The systematic review made the following conclusions that suggest that certain treatments may differentially impact mucositis from different cancer treatments:

- Oral care may be effective, primarily with individuals receiving head and neck radiotherapy.

- Amifostine (Ethyol® an injectable amino thiol free radical scavenger) has some benefit in preventing mucositis and in reducing severity of mild mucositis.

- Benzydamine (available as a generic) with anti-inflammatory, analgesic, and antimicrobial properties, has some benefit in preventing mucositis.

- Hydrolytic enzymes reduce the severity of mild to moderate mucositis in patients receiving treatment for head and neck cancers.

- Ice chips may cause local vasoconstriction and limit the oral toxic effect of certain chemotherapeutic drugs, in particular 5-FU.

- Honey may have antibacterial and wound healing properties that can reduce severity of mucositis.

Effects of a Stannous Fluoride-Impregnated Dental Floss on in vivo Salivary Fluoride Levels

Casey C Flatt, RDH, Donna Warren-Morris, RDH, MEd, Steward D Turner, PhD and Jarvis T Chan, DDS, PhD

Casey C. Flatt, RDH, practicing dental hygienist and a graduate from The University of Texas Dental Branch at Houston; Donna Warren-Morris RDH, MEd, associate professor; Steward D. Turner, PhD, associate professor; Jarvis T. Chan, DDS, PhD, professor. Flatt and Warren-Morris are from The University of Texas Dental Branch at Houston; Turner and Chan are from The University of Texas Medical School at Houston.

Purpose. *The aim of this in vivo pilot study was to determine the concentration of fluoride retained intra-orally in saliva after flossing with dental floss impregnated with stannous fluoride (SnF2).*

Methods. *Participants flossed their teeth ad libitum with 2 premeasured lengths of fluoridated dental floss. Expectorated saliva samples were collected in vials before flossing (PF), immediately postflossing(IPF), at 30 minutes (30), and 1 hour (60) after flossing for analysis with a fluoride-specific electrode and an Orion millivoltmeter. Postflossing samples were compared to the preflossing samples using ANOVA and Tukey's HSD.*

Results. *Differences between the PF and IPF group means were found to be statistically significant at p<0.01. No other significant differences were found between or among any of the groups. Salivary fluoride levels at 60 minutes (60) were similar to those prior to flossing (PF).*

Conclusions. *It can be concluded that fluoride can be released from flossing with the tested SnF2-impregnated dental floss elevating salivary fluoride levels for at least 30 minutes. Use of this fluoride-containing dental floss offers an option for delivery of fluoride to individuals at risk for dental caries.*

Keywords: dental caries, fluoride, dental floss, stannous fluoride

Introduction

Widespread implementation of fluoride has resulted in a significant decline in dental caries prevalence in recent decades.[1-3] Recent evidence-based guidelines from the American Dental Association recommend fluoride therapies for patients at risk for dental caries.[4] Research has documented that fluoride is effective in preventing dental caries through its ability to enhance remineralization, inhibit demineralization of tooth structure, and inhibit the acid production of cariogenic bacteria such as *Streptococcus mutans (S. mutans).*[2,5,6] Even low levels of salivary fluoride have been shown to be capable of causing mineral growth in hydroxyapatite.[7,8] Additionally, "the presence of low, but slightly elevated levels of fluoride in plaque and saliva is the predominate means by which fluoride exerts its anti caries effect."[2,5] In addition to fluoride-containing toothpastes and mouthrinses, dental flosses impregnated with fluoride have been shown to increase fluoride concentration

on enamel surfaces.[9,11] Although previous studies have documented the preventive benefits of fluoride-impregnated dental floss and products, there are no reports of analytical data regarding the intra-oral concentration of fluoride ion in saliva after use of this new stannous fluoride-impregnated dental floss.[9-15] This aim of this pilot study is to determine the fluoride level of whole mouth stimulated saliva after use of a new floss impregnated with stannous fluoride. This study is relevant to the practicing dental hygienist in the selection and recommendation of evidence-based preventive therapies for dental caries.

Review of Literature

Fluoride and De/Remineralization

The dental caries process demonstrates the significance of fluoride concentration on the enamel surface. This process involves the dissolution of calcium and phosphate minerals from the enamel or cementum.[6] As long as these minerals are replenished back into the tooth at the same rate as they are lost, net demineralization (loss of intact surface) does not occur.[6] The rate of the demineralization-remineralization process is affected by several factors including: the quality and quantity of saliva; the presence of fluoride; the quality of the diet; the bacteria present; and the quality of the tooth structure itself. [6]

Fluoride can reduce the rate of demineralization by inhibiting the solubility of tooth structures in acid. Fluorapatite $[Ca^{10}(PO_4)_6F_2]$ that forms in the presence of fluoride is more resistant to acid than hydroxyapatite $[Ca_{10}(PO_4)_6(OH)_2]$ or carbonated hydroxyapatite.[6] Topical fluoride incorporates into the outer surface of the tooth by chemically bonding with calcium and phosphate; thereby, preventing their loss during acid exposures. Fluoride is also capable of attracting additional calcium and phosphate reserves from the saliva, plaque, and diet for deposit back onto the tooth surface.[6]

Even at very low levels, fluoride participates in the remineralization process. In a study conducted by Ingram et al, the mean ppm F in saliva was 0.0175 (± 0.006). At this low level, they found that "mineral crystallite growth resulted with preferential calcium uptake by hydroxyapatite mineral," suggesting that salivary fluoride plays an important role in remineralization.[8] A previous study found no correlation between enamel fluoride uptake and caries reduction.[16] Studies have shown that salivary fluoride levels of 0.03 ppm enhanced remineralization of tooth structures up to an optimal level of 0.08 ppm.[17-20] Other studies have demonstrated a reduction in demineralization of tooth structures at levels of 0.024 ppm F at a pH as low as 4.3.[18-20] It has also been reported that fluoride products initially cause a high level of fluoride in saliva that decreases with time, but can be retained at therapeutic concentrations of 0.03-0.1 ppm F for 2-6 hours.[21,22] Patients with xerostomia were shown to maintain levels for even longer periods due to a low salivary flow rate.[23] Featherstone et al reported that fluoride present in the oral fluids at the time of acid attack can "travel with the acid down into the sub-surface of the tooth, adsorb to the crystal surface and protect it against being dissolved."[2]

Fluoridated Products and Saliva

Studies have reported that salivary fluoride levels can be elevated to therapeutic levels with the use of fluoridated mouthrinses, toothpastes, and chewing gums.[22,24-28] Fluoridated chewing gums were shown to increase levels by up to 50% for 20 minutes.28 Fluoridated dentifrices of 1100 ppm F increased the salivary fluoride levels for 60-120 minutes.[21,22,24-27] Other studies have shown that toothpicks impregnated with fluoride increase the fluoride concentration of saliva in approximal areas and are capable of releasing approximately 0.15 mg F for 2 minutes after use.[29] Kashani et al found that the use of a fluoride-impregnated toothpick or floss (not the test floss in this study) increased the approximal salivary fluoride levels similar to, or somewhat higher than, those resulting from the use of a fluoridated mouthrinse or dentifrice.[30] Other studies comparing administration methods of administering fluoride to inter-proximal areas reported that toothpicks

and dental floss impregnated with fluoride elevated salivary fluoride levels in approximal areas for up to 60 minutes after use.[13,31,32]

Fluoride Effects on Bacteria

Several studies have reported that less acid is produced by bacteria on the tooth surface after an application of SnF_2.[33-37] It is theorized that the stannous ($Sn^{2}+$) ion in saliva reacts and oxidizes thiol groups, thereby preventing bacterial metabolism of carbohydrates or glycolysis.[35,38] One of these studies reported that the stannous ion accumulates in bacterial plaque via interactions with anionic bacterial polymers.[38]

Kashani et al reported that toothpicks impregnated with 8% SnF_2 or 2% chlorhexidine lowered the salivary S. mutans count after 2 days by 73% and 99%, respectively. They reported that there was a small effect on delaying the recolonization of salivary *S. mutans* for a 3-week period.[30] Keene et al found that the addition of SnF_2 to dental floss had a dramatic effect on lowering *S. mutans*.[15] Further, studies have also confirmed the efficacy of fluoride for the growth prevention of S. mutans in vitro.[9,32-37] Ota et al found that SnF_2 significantly reduced the ability of *S. mutans* to cohere to one another after adhering to the tooth; thereby, potentially reducing plaque quantity.[39] Additionally, the use of fluoride-impregnated dental floss has been shown to significantly reduce the number of interproximal *S. mutans* organisms while increasing the fluoride content of the enamel.[10,11,14]

The purpose of this study was to determine the concentration of fluoride in whole mouth stimulated saliva at various time intervals following flossing with a commercially- available stannous fluoride impregnated dental floss.

Methods and Materials

A convenience sample was recruited from a class of 38 second-year dental hygiene students enrolled in the University of Texas Dental Branch at Houston School of Dental Hygiene. All 30 volunteers were female and ranged from 21-32 years of age. The students volunteered as study participants as part of their community dental health course in research design and methodology. On the morning of the study, participants were instructed to refrain from using any fluoride-containing oral products. Participants were excluded if they had brushed, flossed, or rinsed with a fluoridated oral product within 3 hours of sampling or if they reported an allergy to stannous fluoride. Two participants were excluded from the analysis due to unusually elevated salivary fluoride levels in their preflossing samples (0.31 and 0.25 ppm) since this could indicate the use of fluoridated products. All participants had a minimum of 28 teeth.

Participants were asked to floss their teeth *ad libitum* with 2 premeasured lengths of fluoridated dental floss (FlossRx, Omni Pharmaceuticals, West Palm Beach, Fla.) for 90 seconds total. They were instructed to use a different strand for each arch. No further instructions were given regarding flossing technique. The manufacturer information on the package states that the floss delivers 2-4 mg SnF_2 per 2 21-inch strands.

Individual stimulated saliva samples were collected in numbered vials prior to flossing, immediately after flossing, and at 30 and 60 minutes after flossing. Participants were asked to expectorate into vials until 10 ml were collected. Fluoride measurements were conducted for each sample with a fluoride specific electrode (Orion Model 960900) coupled to a millivolt meter (Orion model 811) and recorded for comparison. One individual, not blind to study design, was trained and calibrated to use the equipment and performed all measurements. Only the study PI had the code identifying the numbered vials to both study participants and testing sequence: PF, IPF, 30, or 60. The electrode and meter were tested and calibrated with standard fluoride solution prior to the study.

The study was approved by the institution's Committee for the Protection of Human Subjects. Consent forms were signed and individual participant information was kept confidential.

Statistical Analysis

The quantitative difference between preflossing salivary fluoride levels and postflossing salivary fluoride levels represent the amount of fluoride released by the floss and retained intra-orally during flossing. Comparisons of mean fluoride levels were made between and among the groups with multiple comparison ANOVA using Tukey's HSD Method.

Results

Results are shown in Table I and are reported in ppm F. Means and standard deviations were computed for each group: preflossing (PF), immediately postflossing (IPF), 30 minutes postflossing (30), and 60 minutes postflossing (60). Tukey's HSD intervals for significance were calculated for comparison between groups at the p=0.01 level and found to be 1.21 ppm. In other words, if the difference between group means was 1.21 ppm or greater, the difference was statistically significant. Table I shows that the only statistically significant differences found were between the PF and IPF groups. No other significant differences were found between or among any of the groups. Salivary fluoride levels at 60 minutes (60) were similar to those prior to flossing (PF).

Table I. Comparison of salivary fluoride levels after flossing with fluoridated dental floss.

Preflossing (PF)	Immediately Post Flossing (IPF)	30 minutes Post Flossing (30)	60 minutes Post Flossing (60)
0.12	7.03*	0.23	0.16
0.09	2*	0.18	0.11
0.1	2.79*	0.13	0.1
0.11	6.16*	0.42	0.24
0.09	4.22*	0.19	0.12
0.08	5.86*	0.15	0.11
0.07	9.35*	0.13	0.09
0.16	5.31*	0.22	0.13
0.09	5.91*	0.12	0.08
0.1	8.27*	0.14	0.1
0.11	6.27*	0.18	0.13
0.09	1.96*	0.12	0.09
0.08	10.2*	0.12	0.09
0.08	2.74*	0.2	0.09
0.09	5.2*	0.2	0.13
0.09	2.97*	0.12	0.1
0.09	2.17*	0.12	0.1
0.11	2.96*	0.1	0.09
0.09	12.64*	0.1	0.1
0.13	6.91*	0.22	0.16
0.1	7.76*	0.15	0.13
0.09	9.3*	0.14	0.1
0.08	4.45*	0.11	0.09
0.08	7.58*	0.13	0.09
0.08	4.86*	0.16	0.11
0.07	7.39*	0.15	0.11
0.08	1.31*	0.12	0.12
0.13	5.18*	0.17	0.13
Mean (sd)			
0.1 (0.02)	5.67 (2.80)	0.16 (0.06)	0.11 (0.03)

*Indicates a significant difference.
Means and standard deviations (n=28) given.
Tukey's HSD for comparison between groups at the 0.01 significance level was 1.21 ppm F.

Discussion

This sample of dental hygiene students presented with preflossing salivary fluoride levels above the reported therapeutic level of 0.03 ppm F with a range of 0.07-0.13.[17] The study participants reported that they had not used a fluoridated

product for 3 hours prior to sampling. All of these subjects reported the regular use of fluoridated toothpaste and were drinking water fluoridated at the 0.7ppm F level (Greater Houston area). In the study conducted by Ingram et al, subjects refrained from using fluoridated products for 18 hours prior to sampling and the mean ppm F was 0.0175 ($\pm$ 0.006). This level was lower than that in the present study where the subjects were asked to refrain from use of fluoridated products the morning of the study.[8] This baseline salivary fluoride level was comparable to those reported in 2 previous studies.21,22 Two other previous studies reported baseline salivary fluoride levels much higher than those in this study with a range of 1.1-1.9 ppm F.[24,27] However, baseline values vary with populations and have no impact on level increases since they merely serve as a reference point for comparison.

The results of the salivary fluoride levels immediately postflossing ranged from 1.3 ppm F to 12.64 ppm F. These levels had dropped to a range of 0.1 ppm F to 0.42 ppm F after 30 minutes and were back to preflossing levels at 60 minutes. With the test floss, this study did not confirm the findings of previous studies reporting an elevation of salivary fluoride levels for 60-120 minutes. 21,22, 27,29 These previous studies dealt with highly concentrated dentifrices (1100 ppm F) and rinses (228 ppm F). It is possible that removing saliva from the mouths to test for the IPF could have potentially reduced the salivary fluoride levels measured at 30 minutes and 60 minutes. Future studies could test the salivary levels initially at 60 minutes to prevent this proposed interference and possibly test oral fluids from approximal areas as well.

The large range in IPF fluoride levels may be explained by a difference in flossing technique by some of the individuals. It is possible that using more of the surface area of the floss could result in the release of more fluoride into the mouth. If the individual did not move along the floss to a new area of floss for each tooth, less fluoride potentially could be released and the converse would result in more. Each individual was instructed to floss for 90 seconds to control for this variable. Future studies could include flossing instructions to use a certain amount of the floss strands, but this study was only interested in the results of usual, everyday flossing technique.

The manufacturer reports that 2-4 mg of fluoride is available from the 2 strands of floss and this study demonstrated that it can be released during use. The floss comes pre-packaged with 2 21-inch strands of floss individually wrapped. The floss is available only through a dental office, therefore, patient education can be given to reduce the risk of toxicity or fluorosis for small children as with all fluoridated products. Patients with a risk for dental caries may benefit from the fluoridated floss for mechanical plaque removal, fluoride delivery to interproximal areas, and increase in their salivary fluoride levels.

The use of a stannous fluoride-impregnated dental floss offers an option to the dental hygienist in the selection of evidence-based preventive dental products and techniques. Further research could focus on enamel uptake and actual caries reduction resulting from the use of this fluoridated dental floss over time. Additionally, the test floss should be studied more closely to determine if delivery of fluoride to the interdental areas reduces interproximal caries and/or bacterial loads. Guidelines on the use of this specific floss in children are needed to prevent toxicity and dental fluorosis.

Conclusions

It can be concluded that a therapeutic amount of fluoride can be released from flossing with the tested SnF_2-impregnated dental floss and that salivary fluoride levels are elevated for at least 30 minutes. Use of this fluoride-containing dental floss offers an option for delivery of fluoride to individuals at risk for dental caries.

Notes

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Survey of Oral Health Practices among Adults in a North Carolina Hispanic Population

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Mariola Luciano, RDH, MS, private practitioner, Cary, NC; Vickie P. Overman, RDH, MEd, clinical associate professor, Dental Hygiene; Pamela Y. Frasier, MSPH, PhD, research associate professor, Family Medicine; Enrique Platin, MS, EdD, clinical associate professor, Diagnostic Sciences and General Dentistry. Overman, Frasier, and Platin are all from the University of North Carolina at Chapel Hill. Mariola Luciano was a Master of Science degree candidate at the time of this research. This project served to meet partial fulfillment of the Master of Science degree in Dental Hygiene Education at the University of North Carolina School of Dentistry.

Purpose.The purpose of this study was to collect baseline data pertaining to the oral health of Hispanics residing in Siler City, NC, a microcosm of the flourishing Latino growth found especially in the southeastern United States.

Methods. A convenience sample of 158 Hispanic adults was recruited. A 41-item Spanish language survey was utilized. Questions addressed preventive oral health practices, oral health knowledge and beliefs, perceived needs, and demographic information.

Results. Analysis of data were conducted to find demographic characteristics, frequencies, and correlations. 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) source of oral hygiene instruction and participant's reported brushing or flossing, and dental visit frequency.

Conclusions. This exploratory study found that this population lacks knowledge related to oral health and that they have indicated an overwhelming need for preventive dental prophylaxis. Characteristics found in this population were low income, low education, no dental insurance, and not speaking fluent English. The following suggestions may aid in eliminating dental health care disparities among this population: 1) training and recruiting oral health care providers that are culturally sensitive and speak Spanish; 2) conducting oral health promotional programs sensitive to the needs of Hispanics; 3) Dental Hygiene programs should expand clinical rotations to provide culturally diverse dental hygiene services; 4) changes should be made in North Carolina dental hygiene practice laws to increase care to underserved population.

Keywords: Oral Health Practices, Oral Health Beliefs, Hispanics, Dental Hygiene

Introduction

According to the US Census Bureau, North Carolina is one of the leaders in Hispanic population growth. Between 1990 and 2000, North Carolina experienced a 394% increase in its Hispanic population.[1] As an example, the small town of Siler City, NC had a Hispanic population growth from 4% in 1990 to 39% in 2000.[2] The increased employment of immigrant

workers by the city's poultry processing and textile industries contributed to this growth. Siler City's Hispanic population is mostly comprised of immigrants of Mexican origin. However, there are others from the Caribbean, Central America, or South America.[3]

The increase in the Hispanic population has led to an increase in oral health needs. However, there are only 4 licensed dentists practicing in Siler City. None are of Hispanic origin and none speak Spanish. A new clinic opened in 2005 with a bilingual (English to Spanish) interpreter, yet private pay patients are required to pay fees for all dental services at the time of the visit. The only other service for Hispanics is a dental bus, accessible 1 to 2 times each month, and sponsored by Chatham Hospital's Immigrant Health Initiative and the North Carolina Baptist Men's Association.

Due to limited access to dentists, oral care for this primarily immigrant Hispanic population is a significant challenge. In 2000, the US Surgeon General reported that oral health was essential to general health and well-being. He referred to oral diseases as the "silent epidemic" affecting the most vulnerable citizens, including members of racial and ethnic minority groups.[4]

Minimal information exists for the planning and provision of oral health services to the Siler City Hispanic population. A greater understanding of preventive oral health practices and beliefs regarding oral health among Latinos is imperative in order to appropriately target prevention interventions that are to be developed. Once more knowledge is attained in relation to the oral health habits present in this population, public health initiatives can be taken in order to provide oral health education and preventive services that best fit the needs of this particular population. Therefore, studies are needed to identify the oral health needs of this population. The purpose of this study is to collect baseline oral health data of Hispanics residing in Siler City, NC.

Review of the Literature

Demographics

The Latino population is the fastest growing minority group in the United States. In 2004, the United States Hispanic population was estimated at approximately 40 million people, comprising 14% of the total US population.[5] As growth continues, the Pew Hispanic Center estimates that by the year 2020, the Latino population will reach about 60 million.[6] Not only have the number of Hispanic immigrants increased, but also a younger Hispanic population is attracted to the United States; their mean age of 25 years.[6] Between 1990 and 2000, the strong economy and added job opportunities in the South stimulated strong immigration. With the exception of Nevada in the southwest, North Carolina, Arkansas, Georgia, Tennessee, South Carolina, and Alabama experienced the highest rate of growth. Because of the strong explosive immigration, these 6 Southern states are deemed new Southern Hispanic settlement states.[1]

North Carolina Demographics

In particular, North Carolina experienced substantial growth. The Hispanic population in North Carolina grew from 76 726 in 1990 to 378 963 in 2000.[1] The majority (65%) of the North Carolina Hispanic population is of Mexican origin, but many others are from the Caribbean, Central America, or South America.3 Over half (57%) of the Latinos in the new settlement of the South are foreign born. More specifically, approximately 64% of North Carolina Hispanics are foreign born.[3] Evidence shows that foreign-born Latinos earn the least of all workers in the labor force; one reason offered is their lower level of education. As a whole, 42% of Hispanics in the United States have less than a high school education.[5]

Currently, 23% of the United States Latinos live below the poverty level.[6] Findings show the median weekly earnings for Latinos is approximately $375 for foreign born and $425 for native born.[6] Hispanic growth has had a major impact on specific areas of North Carolina. For example, Siler City, a town located within Chatham County in central North Carolina, has a Latino population (2740) that accounts for 39% of the total town's population.[2] New health care challenges, including oral health care challenges, have resulted.

The Health Belief Model

The Health Belief Model describes that individuals will perform preventive practices in order to deflect disease if they deem themselves susceptible to the condition, if they consider it to have potentially serious consequences, and if they believe that the preventive practice will be beneficial in reducing their susceptibility to or severity of the condition.[7] Most important, individuals must believe that the anticipated barriers to practicing these preventive practices are outweighed by the benefits.[7] However, there are demographic, psychosocial, and structural variables that may influence these preventive health behaviors.[7] In order for behavioral change to succeed, individuals must believe that changing their current behavior will result in a valued outcome at an acceptable cost. Also, individuals must feel competent to overcome perceived barriers that may present themselves in order to take action.[7]

Use of Dental Services Perceived Need

It has become increasingly important for oral health care providers to understand the factors that affect the utilization and access to dental services by this growing Hispanic population. To begin, one must understand the trends in the use of dental services and the perceived needs of Latinos in the United States. Studies show that Hispanics are more likely to seek dental attention in response to pain rather than for purposes of prevention.[8-13]

A 2002 study examined the use of dental services among a Hispanic population of migrant farm workers in rural southern Illinois.[13] The study consisted of a 26-item survey of 119 patients from a local health clinic. About 51% had not sought oral health care in the previous year.[13] Once again confirming previous studies, the majority of migrant farm workers claimed that the lack of pain and discomfort was the reason for not seeking dental care. Other reasons included lack of time, costly fees, and lack of access to available facilities.[13] A similar study was performed in Wichita, Kan using a convenience sample of 75 Hispanic adults.[8] Study participants were asked their reason for not having been to a dentist. Twenty percent perceived no need for oral health care, and 23% reported the inability to find a dentist.

Perceived Dental Needs

In 1995 Watson and Brown gathered information on oral health from the 1985-1986 National Survey of Oral Health in US Adults and Seniors conducted by the Institute of Dental Research. Though data has concluded that 60% of Hispanics reported perceived dental needs, the rate of dental visits appeared to be lowest, with approximately 40% having visited the dentist during the previous year.[10,14,15] Their rate of dental visits was 20% less than that of Caucasians.[14] In addition, data revealed that fewer Hispanics received oral examinations or cleanings while more received emergency care.[14] There were strong ethnic and racial differences in receipt of dental care with adult Hispanics having the highest percentage of never visiting a dentist.[10,12,14,15]

Overall, utilization and perceived need in relation to oral health is low among Hispanics.[16] Though oral health disparities among Latinos should lead to increased utilization, this has not been the case.[15] The aforementioned studies provide supporting evidence that the percentage of adults having never sought dental care is disproportionately higher among minorities, especially Mexican-Americans.[10-13,15] Previous research also shows differences in perceived oral health among ethnic minorities, including Hispanics. Ethnic minorities are more likely to report a more negative oral health status.[17] This leads to concerns regarding the oral health status of Hispanics residing in the United States and their self-care oral health practices.

Oral Health Status and Practices

National Studies indicate Latinos have higher levels of both dental caries and periodontal disease.[14,16] The Lukes and Miller study surveying 119 migrant farm workers in Illinois found that though most individuals brushed at least daily, only 11% used floss daily, and over half had never used floss at all. Of those receiving care, 58% had received brushing instructions and 45% had received flossing instructions. Approximately 50% of those receiving care reported bleeding gingiva, 37%

reported swollen or tender gingiva, and 49% reported tooth loss. Thus, the study concluded that nearly half might have periodontal disease.[13] Similarly, the Vazquez and Swan study using a convenience sample of 75 adult Hispanics found that 85% of respondents brushed their teeth at least once daily. Although 30% reported never flossing, another 38% reported using a toothpick for interdental cleansing.[8]

Data from the1982-1984 Hispanic Health and Nutrition Examination Survey determined that about 46% of Mexican-Americans had gingivitis in comparison to about 8% of the general population.[15] Findings revealed that over 75% of all Hispanic subgroups presented with gingivitis.[12] Less than 4% of all subgroups reported periodontitis as the main reason for their last dental visit.12 Additionally, more current data comparing the National Health and Nutrition Examination Survey III and National Health and Nutrition Examination Survey 1999-2000, characterized Mexican-Americans as exhibiting worse clinical periodontal conditions than non-Hispanic whites.[18]

Findings from Nakazono et al study reveals that increased oral hygiene practices result in lower unmet treatment needs. This demonstrates the importance of oral hygiene practices.[19] However, there are certain behavioral components related to preventive oral health practices that must also be examined. These include knowledge, beliefs, and barriers related to utilization of dental services and oral health practices.

Beliefs and Knowledge of Oral Health and Preventive Practices

The Woolfolk et al study assessed oral health knowledge among a group of migrant worker mothers. Half of the mothers reported that their gums bled. However, few of these women knew what should or could be done about the condition. This same study found women lacking in knowledge about the relationship between oral hygiene and periodontal health.[20]

A study by Adair et al in 2004 examined oral health beliefs among diverse populations, finding that Hispanic adults expressed a more negative belief about the benefit of preventive oral health practices.[21] A similar study conducted on familial and cultural perceptions and beliefs of oral hygiene examined the extent of parental attitudes of oral hygiene practices and the prediction of similar behaviors in their children. This study found that, although Mexican-Americans were very positive about the value of tooth brushing, they were less likely to believe in their ability to implement tooth brushing behaviors.[22]

Barriers

The dental health status and the use of dental services are imperative factors that need to be taken into consideration when dealing with oral health among the Hispanic population. Barriers and attitudes affecting access to oral health care within minority populations include: educational level coupled with cultural values and beliefs, language, lack of access to service, low income, lack of dental insurance, lack of recognition of oral health care, acculturation, and inaccessibility to health professionals of the same ethnicity.[8] The most obvious barrier is assumed to be language. Despite the considerable growth of Hispanics in the US population, very few health care providers speak Spanish.[8] This alone makes it very difficult for Hispanics to maneuver themselves through the US health care system. Language barriers also make it impossible for individuals to establish ongoing health care relationships with their providers.

Acculturation

Acculturation is most often defined as the process of adapting to a new culture; this is most often measured as the changes produced in language.[23] In 1995, Watson and Brown made an observation on access to care based on acculturation from the 1982-1984 Hispanic Health and Nutrition Examination Survey.[14] Watson and Brown found that Mexican-Americans with low acculturation status in the United States had minimal access to care regardless of their needs. They felt that this was due to the differences between the patients' and providers' culture and language. These 2 differences between the patient and provider are important contributing factors when dealing with the lack of preventive care among the Hispanic populace.[14]

A study by Vazquez and Swan found that 41% of Hispanics who spoke English fluently had dental insurance and 53% had a regular place for oral health care. These individuals also showed trends in less time since their last dental visit and dental examinations, and more frequent health care visits.[8]

Ismail and Szupunar conducted a study accounting for acculturation. The study concluded that Mexican-Americans with low acculturation had notably higher mean plaque and calculus index scores.[9] Results revealed that those with low acculturation status had a higher occurrence of both gingivitis and periodontal pocketing.[9] Ismail and Szupunar also concluded that those with low acculturation status (17%) were less likely to be covered by dental insurance than those with a higher acculturation status (44%). Further, about 25% of the low acculturated individuals had never been to the dentist compared to about 6% of those with a high acculturation status. Through further examination, Ismail and Szupunar established that those with low acculturation sought dental care for toothaches and extractions more frequently rather than for preventive measures.[9, 10]

The Cost of Care

The cost of dental care alone is a great barrier to the Hispanic population.[8] National data shows Hispanics, most specifically Mexican-Americans, having low education and income levels.[14, 15] Thirty-eight percent of Hispanics were in the lowest annual income bracket of $12 499 or less and over half (52%) did not have dental insurance.[14] Another survey found that 41% of Mexican-Americans were uninsured, which makes them the highest proportion of uninsured persons in the United States. This investigation indicated that Hispanic adults are more likely to lack access to preventive care. However, findings reveal that privately insured Hispanics do not differ extensively in the utilization of preventive dental services. Publicly-insured individuals were drastically less likely to use dental recalls.[15] Doty and Weech-Maldonado theorized that this was due to a combination of differential treatment and differential use of benefits. Differential treatment may be received due to geographic differences in Medicaid benefits. In 2003, 8 states did not cover adult dental services, and Medicaid benefits vary from state to state. Inadequate dentist participation in the Medicaid program may be a factor affecting treatment as a result of the low reimbursement rates.[15] Differential use of benefits may be due to the lack of acculturation and the increased language barrier present among the publicly=insured Hispanic population. Another factor affecting differential use of service may include dissimilar beliefs about dental care, which in turn affects the pattern of use, and the value placed on preventive dental care among Latinos. Doty and Weech-Maldonado found that enabling resources are important in estimating preventive dental care utilization among minorities. They believe that by reducing discrepancies in insurance participation, access to preventive dental care can be enhanced.[15]

An aforementioned study conducted with a group of Hispanics in Kansas found that 75% of participants lacked dental insurance.[8] Overall, insured individuals averaged less time since their last dental visit and increased the amount of annual dental visits.[8] Confirming earlier findings, the presence or lack of dental insurance greatly affects utilization by the Hispanic community. This same study examined that education beyond high school predicted more dental visits, fewer months since the prior dental exam, and greater frequency of oral care. Those with a higher education level perceived their dental health status as superior, recognized greater oral health needs, and were less likely to delay seeking care.[8] Data shows that Mexican-Americans with less than a high school education have a higher prevalence of periodontal disease.[24] Overall, data has revealed education, dental insurance, and acculturation as the important predictors of dental care utilization.[12]

Research Agenda for Latino Oral Health

In 2004, the Hispanic Dental Association and the University of Puerto Rico met in order to develop an agenda for future Latino oral health research. Though national surveys provide important data about health issues among Hispanics, this data only provides a macro view of the Hispanic population within the United States.[23] The only published national survey to date focusing on Latino health issues was the 1982-1984 Hispanic Health and Nutrition Survey. Though this study provided an abundance of information about Latinos, the study was conducted when the number of Hispanics in the United States was dramatically lower.[23] This is why Ramos-Gomez et al suggest that more data is needed analyzing the US Latino

population. This study proposes population-based, social and behavioral sciences, and health promotion and communications studies as urgent priorities within Hispanic research.[23] This proposal supports the research agenda of the American Dental Hygienists' Association, which states that studies should be conducted on the preventive oral health behaviors of diverse populations.[25] Such research may aid in the plan for the elimination of oral health disparities as suggested by the 2000 Surgeon General's Report on Oral Health.[4]

Methods and Materials

A descriptive questionnaire research design was utilized. The primary investigator, a native Spanish speaker, drafted the questionnaire in English, and translated it into Spanish. It was pretested using bilingual allied dental professionals from a local Hispanic dental practice. Allied dental professionals represented M exico, Venezuela, and Colombia. The primary investigator incorporated suggested changes, adjusting for differences in dialects. The thesis committee reviewed the questionnaire and recommended final changes. The Institutional Review Board of the University of North Carolina reviewed and approved the survey instrument in August 2005. In order to aid in the minimization of misinterpretation by study participants, a pilot questionnaire was administered. Five individuals, from the community where the questionnaire was ultimately carried out, were recruited from patients visiting a local dental bus. After completing the questionnaire, patients provided written feedback on the questionnaire length, the clarity of the questions, and the amount of time needed for questionnaire completion. No further changes to the 41-item questionnaire were suggested.

The questionnaire was divided into 6 sections: dental health care habits, dental visits, condition of gums, knowledge and beliefs about periodontitis, concerns about teeth and gums, and demographic information. Sections pertaining to dental health care habits, dental visits, and condition of gingiva included multiple-choice questions. In the section pertaining to dental visits, respondents were asked to choose all that applied for the reason of their last dental visit. Therefore, more than one response could have been chosen for this question. Similarly, participants were asked to select the common signs of periodontal disease; once again, participants were asked to circle all that applied. The questions related to oral health beliefs utilized 6 Likert-type questions. For example, "I should only visit the dentist if I am in pain." Participants were asked to choose a response from a 5-point Likert-type scale: strongly agree, agree, not certain, disagree, or strongly disagree. The demographic information section included gender, age, income, education, country of origin, length of residence in the United States, and whether or not the respondents had dental insurance. The last section of the questionnaire asked participants to choose all of their perceived dental needs from the following procedures: do not need dental treatment, tooth that hurts, dental check-up, cleaning, tooth pulled, treatment for gum disease, broken tooth, teeth straightened, sores, fill in gaps between teeth, all teeth pulled, gold removed, dentures, and other.

Prior to survey implementation, Lay Health Advisors from Chatham Hospital's Immigrant Health Initiative and volunteers from Santa Julia Catholic Church were calibrated to the prescribed procedures for administering a questionnaire as it relates to human research issues. This was accomplished in Spanish by the principle investigator. This training was previously utilized by researchers at the University of North Carolina School of Public Health with a similar group of lay health advisors. Following the training session, all recruiters were required to obtain a score of 80 or better on the posttest.

For the study, inclusion criteria included male or female Hispanic individuals between 18 and 64 years of age. Exclusion criteria included those of non-Hispanic origins and individuals younger than 18 years of age and older than 64 years of age. The convenience sample approached 5% of Siler City's total Hispanic population.

Questionnaires were completed following 2 Sunday worship services on September 25, 2005, at Santa Julia Catholic Church in Siler City, NC. Individuals attending Sunday worship had equal opportunity to participate voluntarily in the study. Consent to participate was implied by the participant's completion of the 15-minute questionnaire. No identifying markers were included in the questionnaire; it was completely anonymous. The primary investigator was present during the questionnaire completion in order to ensure the integrity of the project. The majority of individuals completed the questionnaire independently. Lay health advisors were available to assist those who asked for help and those requiring assistance reading the survey. After completion of the questionnaire, respondents were offered oral health literature, oral physiotherapy aids, and a telephone calling card.

Following data collection, questionnaires were numbered for ease in data entry. Data from the questionnaires were manually entered into a Microsoft Excel Spreadsheet. At the completion of data entry, all questionnaires were reviewed for verification. Data was analyzed using SAS version 9. Frequencies and bivariate analyses were obtained from the data.

Results

A total of 158 questionnaires were collected. Five were excluded from analysis; four respondents did not meet the age criteria and one did not meet the criteria of Hispanic ethnicity. Therefore, a total of 153 questionnaires were analyzed.

Demographics

Slightly more than half (54%) of the respondents were female. The mean age was 33.8, with a range from 18 to 62 years of age. High proportions (84%) of respondents were of North American Hispanic origin (Mexican), with 15% having a Central American origin, and less than 1% having a South American origin. The mean time of residence in the United States was 106.[8] months with a range from 2 to 492 months. Approximately 80% of the respondents reported their weekly income, with a majority of individuals reporting $201-$400 weekly. In addition, respondents were asked to record their highest level of school completed. Educational categories included none, primary, secondary, preparatory (private high school), and higher education. The majority of individuals responded to having either a primary, secondary or preparatory education. A minority (3%) of questionnaire participants had no educational background and a few (7%) had some type of higher education. Furthermore, a majority (71%) reported having no dental insurance. About 4% did not know their dental insurance status.

Dental Health Care Habits

As stated in the Methods section, 3 questions pertained to tooth brushing habits. The first question asked individuals how often they brushed their teeth. Figure 1 indicates that about 66% reported brushing more than once daily, with about half brushing 2 times daily. Fifty-one percent of individuals reported having brushed 2 times "yesterday" (Figure 2). When asked who taught them how to brush their teeth correctly, participants were required to choose only one response. Survey participant responses were divided into 4 categories: no one/myself, family member, professional (teacher, dentist, dental hygienist, dental worker), and other. A large number of individuals (46%) reported having been taught by a family member.

Figure 1: Brushing Frequency
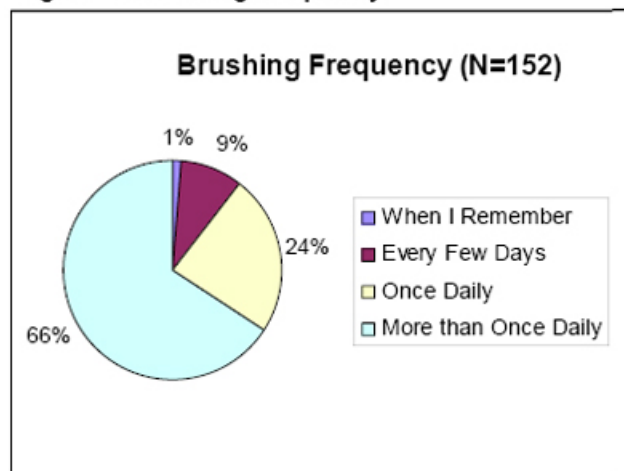
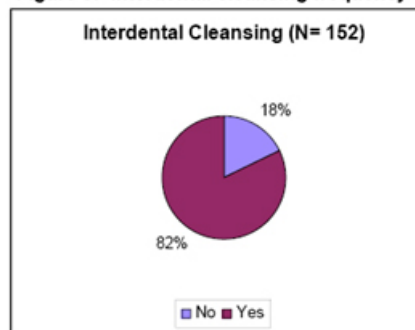
-Percentages were rounded to whole decimal place

Figure 2: Brushed yesterday frequency

Brushed Yesterday (N=153)
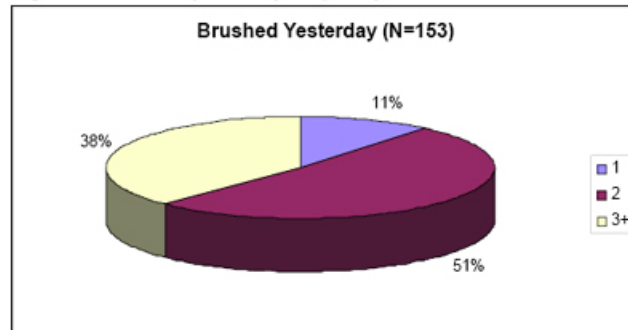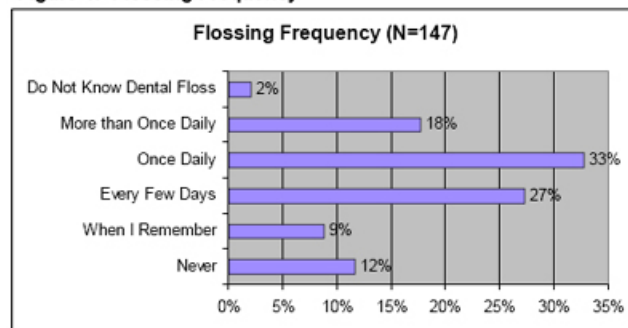

- Percentages were rounded to whole decimal place

Five questions dealt with dental flossing. First, participants were asked whether or not they cleansed between their teeth. Approximately 125 participants (82%) responded "yes" to interdental cleansing (Figure 3). Those responding "yes" were then asked to answer 4 additional questions about flossing frequency (Figure 4). When asked to indicate the number of times individuals flossed "yesterday", forty-six percent responded 1-2 times (Figure 5). Additionally, the questionnaire asked for the number of times individuals flossed "normally." The majority (62%) responded 1-2 times daily (Figure 6). Moreover, individuals were asked who taught them how to properly floss their teeth; 42% had never received flossing instruction.

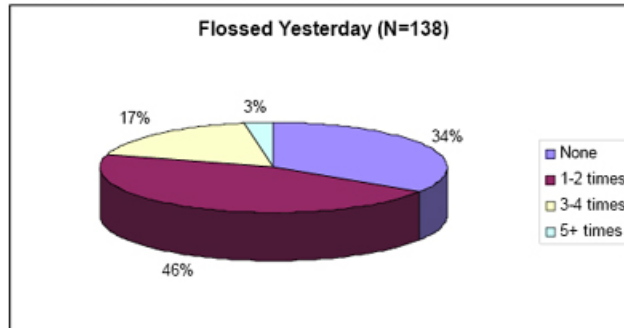**Figure 3: Interdental cleansing frequency**

Interdental Cleansing (N= 152)

-Percentages were rounded to whole decimal place

Figure 4: Flossing Frequency

Flossing Frequency (N=147)

-Percentages were rounded to whole decimal place

Figure 5: Flossed yesterday frequency

Flossed Yesterday (N=138)

-Percentages were rounded to whole decimal place

**Figure 6: Flosses normally frequency**

Flosses Normally (N=133)
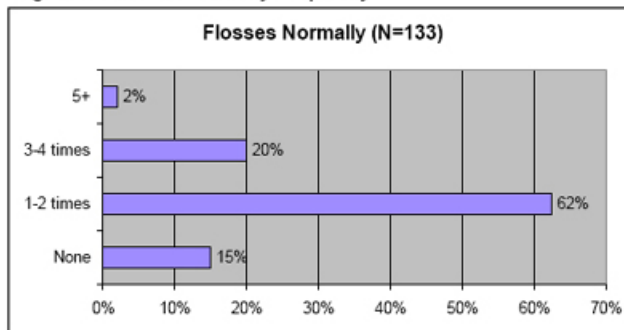
-Percentages were rounded to whole decimal place

Dental Visits

The survey included 3 questions related to dental visits. Participants were first asked if they had ever had a professional cleaning conducted by a dental hygienist or a dentist. Approximately 87% reported "no" or "never" (Figure 7). Participants were then asked to recall their last dental visit. Less than half (42%) responded that they had visited a dentist within the last year; about 19% responded it had been at least 2 years since their last dental visit. Approximately 7% reported 3-4 years since their last dental visit; about 11% responded "greater than 5 years," 11% responded "never;" and about 9% reported they "did not remember." Finally, respondents were asked the reason for their last dental visit; 39% stated their last dental visit was for a cleaning.

Figure 7: Frequency of individuals ever having a professional dental cleaning

Professional Cleaning
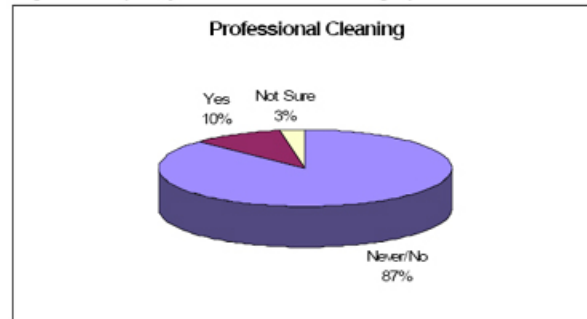
Gingival Condition

When participants were asked whether their gums bled when they brushed or flossed their teeth, more than half of the participants (52%) indicated bleeding.

Knowledge and Beliefs

Respondents were asked to identify the common sign of gums disease, choosing all that applied: swollen, inflamed, or bleeding gums; continual bad breath; loose teeth; gums that are pulling away from the tooth; other; and do not know. Most individuals (66%) responded that swollen, inflamed, or bleeding gums were common signs of gums disease. Twenty-five reported bad breath, 14% reported loose teeth, 5% reported recession, and 1% reported other as common signs of gum disease.

Participants were asked to rank their beliefs about gum disease. About 65% strongly agreed that brushing their teeth could help prevent gum disease. However, less than half (45%) strongly agreed that flossing could also help prevent gum disease. More than half of the respondents (64%) stated that they strongly agreed that it was important to visit the dentist every 6 months. Most individuals either disagreed or strongly disagreed that one should only visit the dentist if in pain. Furthermore, approximately one-third (37%) of individuals stated that they were not certain if healthy gums bled occasionally. In addition, large percentages (41%) were not certain if tooth loss was a normal part of aging (Table 1).

Table 1: Percentage of responses related to beliefs about gum disease

	SA/A	NC	D/SD
Brushing my teeth can help prevent gum problems. (n=145)	89.6	9.7	0.7
Using dental floss helps prevent gum disease. (n=144)	82.6	16.0	1.4
Going to the dentist every six months is important. (n=142)	91.6	8.5	0.0
I should only visit a dentist if I am in pain. (n=136)	11.8	11.8	76.5
It is normal for healthy gums to bleed occasionally. (n=137)	19.7	36.5	43.8
I will lose my teeth as I get older. (n=140)	27.8	41.4	30.7

-SA- Strongly Agree; A- Agree; NC-Not Certain; D- Disagree; SD- Strongly Disagree

Perceived Needs

Respondents were asked to choose all of their perceived dental needs. A majority (72%) chose dental cleaning as a perceived need, followed by dental checkup (37%) and dental filling (32%) (Table 2).

Table 2: Latinos' Perceived Dental Needs By Frequency of Response

(N=148)	%
Dental cleaning	72
Check up	37
Fillings	32
Treatment for gum disease	24
Tooth that hurts	24
Broken tooth	23
Tooth extracted	18
Teeth straightened	17
Gaps filled	14
Other	14
No treatment needed	12
Mouth sores	10
Removal of all gold	5
Dentures	3
All teeth pulled	2

-Respondents reported all that applied

Bivariate Analyses

Bivariate analyses were performed using Mantel-Haenszel correlation tests. Correlations revealed strong evidence of a statistically significant association between who taught individuals how to floss and their flossing frequency (p-value ≤

0.05). In particular, those who were taught how to floss by a family member or a friend had the highest average flossing frequency. Those who were taught to floss by a professional had the second highest average, and those who were never taught or who were self-taught had the lowest average flossing frequency. No evidence indicated statistically significant correlation between brushing frequency and who taught individuals to brush their teeth.

Further, statistically significant correlations were found between who taught individuals how to floss and last dental visit (p-value ≤ 0.05). Specifically, those who were taught how to floss by a professional had the least time since their last dental visit. Those who were not taught, self-taught, or taught by a family member or friend had similar average time since their last dental visit, but lower than those taught by a professional.

Furthermore, evidence revealed a statistically significant association between who taught individuals how to brush and their last dental visit (p-value ≤ 0.05). Those who were taught how to brush by a professional had the least time since their last dental visit. Those who were not taught, self-taught, or taught by a family member or friend had a similar average of time since their last dental visit, but lower than those taught by a professional.

In addition, a statistically significant association existed between dental insurance and last dental visit (p-value ≤ 0.05). Those with dental insurance had significantly less time since their last dental visit. Additionally, evidence of a statistically significant association between brushing frequency and the belief that healthy gums bleed was found (p-value ≤ 0.05). A Spearman correlation coefficient of -0.1745 indicates that higher brushing frequencies were associated with higher rates of disagreement that healthy gums bled. There was no evidence of any statistically significant association between floss frequency and knowledge of gum disease. Similarly, no evidence of statistically significant association was found between flossing frequency and familiarity with signs of gum disease. Also, no association was found with flossing frequency and whether or not individual's gingiva bled upon brushing or flossing.

Moreover, associations between last dental visit and self-reported perceived needs were found. Individuals reporting not needing a dental cleaning had less time since their last dental visit in comparison to those who responded needing a dental cleaning (p-value ≤ 0.05). No other associations were found.

Discussion

The Hispanic population in Siler City, NC is a microcosm of the Hispanic population in North Carolina, with a majority of Mexican decent, a mean age of about 34 years, low income, and lack of education. The average length of residence in the United States is approximately 9 years. Having lived in the United States only 9 years, these foreign-born individuals may be less acculturated. Therefore, language, health care delivery system, and differing beliefs about prevention are a few of the barriers that prevent these individuals from acquiring proper oral health care. It is important to mention that although other populations experience health disparities, there are differences in access to care among Hispanics because of ineligibility for Medicaid or other state-funded insurance programs due to the legal status of these individuals. Again, 84% of the individuals in this study are of foreign origin, and therefore may not be eligible for Medicaid.

Consistent with other findings, there was a lack of dental insurance within this population. This may lead to low use of dental services due to the high cost of professional oral health care. Once again consistent with previous findings, dental treatment was most often sought for palliative reasons rather than preventive reasons, with a majority of respondents having never had a preventive dental prophylaxis. This could be due to the lack of knowledge about gum disease within this population. In this study, 87% reported never having a professional dental cleaning; however, 39% stated their last dental visit was for a cleaning. This discrepancy may have occurred because individuals sought a professional dental cleaning at one time but due to circumstances were not able to receive that care. It also may be that when individuals visited the oral health care provider, they were overwhelmed with the system and the treatment plans they received, or it may have been due to access to care issues. Though the Siler City population has access to a dental bus that provides limited services, the need is much higher than can be met in a bus that is only available for 1 to 2 days a month. Though many individuals were aware of the cardinal signs of inflammation as being indicators of gingival disease, few were aware of other signs such as: bad breath, recession, or loose teeth. Also, the majority of participants agreed that brushing and

flossing could help prevent gum disease, and that going to the dentist every 6 months is important. However, individuals were less knowledgeable about whether healthy gums bled, or if tooth loss was a normal part of aging. Though over half of respondents reported having bleeding gingiva, providing evidence that these individuals have gingivitis or periodontitis, the majority of respondents reported never having a professional dental cleaning.

Overall, findings from this study suggest that self-reported dental homecare was adequate among this population. About half reported brushing more than once daily and a majority reported interdental cleansing. This is not consistent with national surveys, which reveal that only 40% of the overall US population utilizes dental floss on a regular basis.[26] However, there are other modalities of interdental cleansing that could be used, such as toothpicks. It may be that respondents chose a response that was socially acceptable. This is one reason self-reported data should be interpreted cautiously.

Unique to this study, analysis revealed that the source of oral hygiene instruction had an effect on brushing and flossing frequencies and time since last dental visit. More specific, individuals who were taught to floss by a dental professional were more likely to have higher frequencies of home care practices. Also, individuals taught to floss and brush by a dental professional had less time since their last dental visit. This finding has not previously been noted. Furthermore, participants were asked to report their perceived dental needs. This was not a clinical evaluation by a dental professional, but rather self-reported by the individual participants. Therefore, actual treatment needs may differ extensively from the reported ones. However, almost three-fourths reported needing a dental cleaning. Though there is such a high demand for preventive professional cleanings, culturally sensitive services are lacking in Siler City, NC.

This exploratory study had several limitations, including: a small sample size, convenience sample, incomplete surveys, and self-reported data. Further investigations should be made using a much larger sample size. The convenient sample population reached only about 5% of the total Hispanic population of Siler City. Collecting data after Sunday worship services attracted a Hispanic population with mobility; many Hispanics have no transportation and may be isolated. Therefore, this population may have more access to care because they have transportation. Also, many of the respondents did not answer all of the questions; this reduced the effectiveness of the sample. A "gold standard" longitudinal study would provide more valuable data in relation to oral health status and utilization. Further investigations should seek to collect data on actual dental needs rather than self-reported perceived needs. Generalizations are limited to those individuals participating in the study. All data was self-reported, therefore this data should be interpreted carefully. Misinterpretations could have occurred during survey delivery. Though the primary investigator that translated the survey is a native Spanish speaker, participants of the study may have created differing interpretations to the questions. Lay health advisors aiding with the survey implementation were all fluent in Spanish and very familiar with the cultural attributes of the sample population. Lay health advisors only aided those that asked for assistance. However, there could have been variability in the way lay health advisors delivered the survey, which could have lead to differing results.

Conclusions

This exploratory study found that this population lacks knowledge related to oral health. An overwhelming perceived need for preventive dental prophylaxis was reported by participants. Also, low income, low education, no dental insurance, and language are some of the barriers that have been previously found to interfere with individuals seeking dental care. Therefore, the following suggestions are made that may aid in eliminating dental health care disparities among this population. It is important to recruit and train oral health care providers that are culturally sensitive to this population and that can speak Spanish fluently. Dental terminology and oral health needs can be difficult for individuals to understand. Moreover, it makes it much more difficult when the patient and the health care provider speak a different language. Removing the language barrier alone can lead to further education about oral health and its connection to overall health; therefore, decreasing oral health disparities. Extensive oral health promotional programs are needed that are particularly sensitive to the Hispanics of Siler City. It is also important for dental hygiene programs in North Carolina to encourage their dental hygiene students to become more culturally sensitive to the needs of Hispanics in the state. Trends show that the Hispanic population is going to continue to grow extensively. Dental hygiene programs should expand their clinical rotations in order to provide cultural diversity in the curriculum and to serve the underserved Hispanic population of North Carolina. Increasing programs that immerse students into different cultures and clinical practice experiences can motivate them to further seek these opportunities throughout their career.

North Carolina laws do not currently allow dental hygienists to work independently, or without the supervision of a dentist. Changes in these laws, particularly when dealing with underserved populations, could lead to more preventive services being provided and more dental health needs being met.

Notes

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Moving Research Knowledge into Dental Hygiene Practice

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Dental hygiene, as an emerging profession, needs to increase the number of intervention studies that identify improvements in oral health outcomes for clients. Historically, dental hygiene studies have typically been atheoretical, but the use of theoretical frameworks to guide these studies will increase their meaningfulness. Rogers' theory of diffusion of innovations has been used to study research utilization across many disciplines, and may offer insights to the study of research use in dental hygiene. Research use is an important component of evidence-based practice (EBP), and diffusion of research knowledge is an important process in implementing EBP. The purpose of this paper is to use diffusion of innovations theory to examine knowledge movement in dental hygiene, specifically through the example of the preventive practice of oral cancer screening by dental hygienists, considered as an innovation. Diffusion is considered to be the process by which an innovation moves through communication channels over time among a social network. We suggest diffusion theory holds promise for the study of knowledge movement in dental hygiene, but there are limitations including access to and understanding research studies as innovations. Nevertheless, using a theoretical framework such as Rogers' diffusion of innovations will strengthen the quality of intervention research in dental hygiene, and subsequently, health outcomes for clients.

Keywords: Diffusion of innovations, evidence-based practice, research utilization, theoretical frameworks, dental hygienists

Background

Dental hygienists, as oral health practitioners, strive to provide health care services that will result in optimal oral health outcomes for their clients. Using an evidence-based practice approach is intended to contribute to maximizing such outcomes.[1] Research utilization is an important component of evidence-based practice (EBP), and diffusion of research knowledge is an important process in implementing EBP. Moving knowledge from research into dental hygiene practice presents challenges that can be better understood and addressed by examining the social and professional contexts in which dental hygienists practice. It is important that we conduct studies about how research knowledge moves into practice in dental hygiene, in order that future efforts to promote EBP are consistent with empirical findings about successful knowledge movement in dental hygiene practice. The use of a theoretical framework, such as Rogers' theory of diffusion of innovations, provides a mechanism for studying knowledge movement, or diffusion, among practitioners.[2]

Evidence-based practice (EBP) is defined as an "... approach that integrates the best external evidence with individual clinical expertise and patients' choice."[3] Despite the active promotion of the concept of practice based on current research evidence by professional dental hygiene organizations in Canada and the United States studies show variation among

practitioner behaviour . For example, a number of studies of dental Hygienists' practices with regard to oral cancer screening (OCS) found that, in many cases, practitioners' knowledge was not consistent with current scientific findings, and when knowledge was current, practices were not necessarily consistent with that knowledge.[4-6] Putting the knowledge obtained from research into practice operationalizes evidence-based practice, but from this example it is apparent that this process is much more complex than existing models for EBP suggest, with their focus on individual actions in seeking new knowledge.[7-10] In this paper we use Rogers' theory of diffusion as a framework for examining, via existing literature, the complexities associated with diffusion of OCS into practice.

Rogers' Theory of Diffusion of Innovations

Rogers' theory of diffusion of innovations[2] may hold some promise for developing an understanding of knowledge transfer in dental hygiene, and has already been used to study the information-seeking behaviours among dental hygienists. Rogers defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system.[2] A wealth of studies, mostly descriptive and correlational, have described the spread of change as innovations have diffused through given populations.[11] Many of these studies have examined relationships between the attributes of the innovation, the communication channels used to spread knowledge of the innovation, characteristics of the social system of potential adopters, and the time it takes for implementation of the innovation to occur.

There is a rich tradition of diffusion research occurring across many disciplines, and this theoretical framework has been used to study diffusion, for example, in medicine,[2,11,12] nursing,[13] dentistry,[14] and dental hygiene.[15,16] Covington studied uptake of fluoride guidelines among practicing dental hygienists in northern British Columbia[15], and Finley-Zarse and her colleagues used diffusion of innovations as the theoretical framework to describe the demographics of adopter categories in her study of computer-based information gathering behaviours among US dental hygiene educators and practitioners[16]

Rogers has defined an innovation as an idea, object, or practice that individuals perceive as new.[2] It may have been in existence for some time, but may not have been adopted by all members of a social system yet. For the purpose of this paper, we will consider the example of the preventive practice of oral cancer screenings by dental hygienists to be the innovation under consideration. Although the terms 'screening' and 'examination' are sometimes used interchangeably in the literature, we have used the terms 'screening' and 'oral cancer screening (OCS)', consistent with Wilkins' definitions, where a screening implies the potential for referral for further in-depth examination.[17] Implicit in this definition is the assumption that an examination would lead to a diagnosis, whereas a screening would lead to a referral for diagnostic purposes.

Of known oral diseases & conditions, oral cancer is the only one that can and does frequently lead to death, and often leads to severe disfigurement. Dental hygienists can contribute to reducing morbidity and mortality associated with these cancers.[4] Although relatively widely known for some time, this practice has not yet been adopted consistently into regular dental hygiene practice. Syme, Drury, & Horowitz studied behaviours of Maryland dental hygienists related to assessment of patients' risk for oral cancer, and found while the majority probed for present tobacco use, fewer probed for past tobacco use and still fewer probed for present or past alcohol use.[6] Those who provided more comprehensive screenings were more likely to feel adequately prepared to provide tobacco cessation education. Horowitz, Siriphant, Canto, and Child found that dental hygienists perceived a lack of time and lack of expectation on the part of their employer dentists to conduct oral cancer exams.[5] They identified discomfort and uncertainty about their skills for providing comprehensive oral cancer examinations. Forrest, Horowitz, and Shmuley noted inconsistency between knowledge and practitioner behaviour with regard to oral cancer screening.[18] Clovis, Horowitz, and Poel studied Canadian dental hygienists in Nova Scotia and British Columbia and found inconsistency between knowledge, and the application of that knowledge, in providing oral cancer examinations.[4] It is believed by many that evidence-based practice will contribute to reducing variation among practitioners, as they come to embrace the most current evidence for practice. The challenge is to identify ways to move knowledge from research into practice in a more timely manner than is currently occurring. The purpose of this examination of Rogers'

diffusion of innovations theory is to consider whether it may provide a useful framework for studying interventions to actively diffuse knowledge from research such that it results in implementation in practice. If we are to characterize OCS or any other findings from research as an innovation, we need to describe it in terms of each of the elements in the diffusion process.

Attributes. This theory contends that the rate of diffusion is related to 5 attributes of the innovation, the first element in Rogers' definition, as perceived by potential adopters. These 5 attributes are relative advantage, compatibility with existing values, complexity, trialability, and observability. If an innovation has a greater relative advantage than the idea it is replacing, it will be taken up more rapidly. If an innovation is more compatible with existing values, beliefs, past history, and needs of the potential adopters, it is more likely to be taken up sooner. If an innovation has low complexity, is easy to understand and use, it is more likely to be taken up early than if it is very complex and difficult to understand and use. If an innovation is trialable, that is - it can be tried in a small way by a potential user such that they can see its advantages and achieve success, it is more likely to be adopted. If an innovation is observable and can be noticed by others and observed by those considering adoption, it is more likely to diffuse rapidly. Between 49% and 87% of the variance in adoption rates can be explained by these 5 variables.[12]

When considered against the attributes, OCS has mixed results. In terms of relative advantage, OCS does not replace an existing practice; rather it is in addition to (an adjunct to) existing intra- and extra-oral examination processes. This may not be perceived as an advantage by practitioners, rather some may consider it to take more time than is available. Clovis et al pointed out that "The single most critical intervention influencing survival is early detection,"[4] consistent with the notion of greater relative advantage. Investigators found a rather complex interplay of factors, including confidence in skills and knowledge, perceived time constraints, and unclear influence of practice and professional context for supporting routine OCS by hygienists, suggesting that the advantage of early detection may be moderated by other influences.

OCS can readily be seen to be compatible with dental hygiene's existing values of disease prevention and health promotion. It also aligns well with professional models of practice, rather than occupational models.[19] A challenge for dental hygienists is that historically, this was not a role for dental hygiene practitioners, but rather was assumed by dentistry. Clovis et al recently found 20% of dental hygienists still believed it was the dentists' role to provide this screening.[4] The continued movement from an occupational culture to a professional culture may positively improve this acceptance of dental Hygienists' responsibility over time. As this is an additional service and does not meet a specific identified need of practitioners, nor does it have a fee associated with it, routine incorporation of OCS is not straightforward.

Innovations that are of low complexity are more likely to diffuse rapidly, and some would suggest OCS is low complexity. Prout et al suggest that screening can be taught to nurses and other primary health practitioners in one hour, and they can successfully use the technique to identify and refer lesions, using a standardized form.[20] However, Clovis et al found that even though nearly half of dental hygienists surveyed felt their knowledge of OCS was current, fewer still were likely to provide this screening, even when they knew it was necessary.[4] Despite the fact that OCS can be a "death-defying act" requiring only a few minutes of time,[21] one explanation for this reluctance to perform a seemingly low complexity screening may be that OCS is associated with the higher complexity skill of interpretation and judgement.

Communication channels. The second element in Rogers' definition is the use of communication channels, and diffusion research has found that different communication channels are more useful at different times in diffusing different kinds of knowledge among potential adopters. There are 3 main types of knowledge about innovations: awareness knowledge - that the innovation exists; how-to knowledge - subjective evaluation knowledge of how to incorporate the innovation into practice; and principles knowledge - functioning principles underlying how the innovation works. Mass media channels are best for communication of awareness knowledge, and interpersonal channels are best for communicating information about "how to" knowledge, in particular subjective evaluation knowledge about the innovation. Awareness knowledge can be communicated from outside the social system, but diffusion studies have shown that, other than the most innovative of potential adopters, most do not evaluate their potential decisions to adopt on the basis of scientific studies.[10] Most people within a social system prefer to receive subjective evaluation information, "how to" knowledge, about an innovation from a near-peer within their social system, and this transfer of knowledge occurs primarily through social interaction.

Dental Hygienists' awareness and principles knowledge are most likely to have been acquired during basic education and continuing education. Their decision to incorporate OCS, which according to diffusion studies would typically be based on subjective evaluation of near peers, is more complex. Studies have shown that dental hygienists request more continuing education (CE) about oral cancer and performing OCS, yet CE has not translated into changed practice behaviours,[4-6] and preliminary studies of knowledge sources show high use of experiential sources (personal experience, knowledge from clients)22 and interpersonal sources.[17,23]

Dental Hygienists' comfort with principles knowledge, reflecting the underlying principles of how OCS works, may be influenced by differences among guidelines regarding OCS. The Canadian Task Force on Periodic Health Examination (CTFPHE), the American Cancer Society (ACS), and the US Preventive Services Task Force guidelines demonstrate a lack of consensus regarding screening, with ACS recommending routine screening every 3 years for those between the ages of 20 and 40, and annually for those 40 and over.[4] The CTFPHE does not include a recommendation for OCS, but Clovis points out it is critical to note that this stems from a lack of evidence rather than evidence of no benefit.

Time. The decision to adopt an innovation does not occur simultaneously with first knowledge of the innovation; rather it is a process that occurs through a series of 5 steps over time. The first step is knowledge of the existence of the innovation, followed by persuasion or forming a favourable or unfavourable attitude toward it. The third step is the decision step, when the potential adopter makes a decision to adopt or reject the innovation. If the decision is to adopt, the fourth step is implementation, which can and frequently involves reinvention of the innovation to fit the local context. The fifth step is confirmation, when the adopter seeks reinforcement or possibly support to confirm that the decision is right and functional. The length of time for the innovation-decision period can vary, and can take years from awareness to adoption and confirmation.[2]

There are no studies that have looked at time related to diffusion of research innovations within dental hygiene.

Social system. Other factors that influence the spread of adoption are characteristics of the individuals within the social system, frequently referred to as adopter characteristics. These characteristics are generally described in terms of the individual's innovativeness, or how early they are to adopt new ideas. Various studies have found that these groups approximate a normal frequency distribution.[2] See Figure 1 for an illustration of the frequency distribution of adopter categories. The first group, the smallest at about 2.5% of the total population, and found 2 standard deviations above the mean, are innovators. These are active information seekers who have wide external networks, travelling further to communicate with others and seek information (Rogers calls them cosmopolite), and a high degree of exposure to mass media. They are able to cope with some uncertainty and do not depend on subjective evaluations of others within their social system. The next group, between 1 and 2 standard deviations above the mean, or 13.5% of the population, are early adopters. They are more connected to the local social system than innovators, and have a high degree of local opinion leadership. They have some network connections outside of the local system to find out about innovations, communicate readily with each other, and have a short innovation-decision time period. They can and do report on the innovation if asked. Some have suggested that there may be great advantage to the intentional use of opinion leaders to aid in strategic diffusions (see Figure 1).[24,25]

Figure 1. Distribution of Adopter Categories on the Basis of Innovativeness.

The next group, the early majority, are distributed about 1 standard deviation above the mean, and comprise about 34% of the population. This group adopts just before the average adopter and are well connected with their peers in a local network. They are not opinion leaders but watch opinion leaders' actions with the innovation. This group relies on personal familiarity, rather than science, to assist their decision to adopt.[11] As this group begins adopting the innovation, it is said to reach "critical mass," at which point the diffusion takes off and begins to spread with less external influence and more as a result of internal influences and information sharing. The next group, the late majority, distributed 1 standard deviation below the mean and making up approximately one-third of the population, are more conservative and adopt as a result of peer pressure, and after all uncertainty has been removed about the process. The final group, referred to as laggards, comprise approximately 16% of the population, and are the most localite and isolated with their smaller, locally-based social system networks. They may be resistors, or just ultra-cautious and wishing to stay with the "tried and true."[11]

Finley-Zarse and her colleagues classified dental hygiene educators and practitioners by Rogers' adopter categories based on their frequency of use of computer-based information sources.[16] They found statistically significant differences between educators and practitioners, with educators more likely to be classified as early adopters or early majority, and practitioners more likely to fall into late majority or laggard classifications.

So what do we know about the influences of the social system on dental Hygienists' uptake or adoption of research findings? There have been few studies of information-seeking practices and research utilization behaviours of dental hygienists. In an early study, Gravois and her colleagues found the main sources of information for practice were discussions with colleagues and browsing journals, books, and newsletters, while conducting or having someone else conduct a database search was used infrequently.[26,27] Covington and Craig, using Rogers' diffusion theory to study diffusion of a clinical guideline related to fluoride, found the most frequently utilized information sources to be discussions with colleagues, journal articles, mailings from professional associations and the licensing body, textbooks, and CE courses.[23] They also found low usage of computerized information sources, but this study, conducted in 1996, was somewhat early relative to the diffusion of computers and their general use patterns. The findings of discussions with colleagues are consistent with literature on diffusion of innovations that suggests the importance of personal contact for sharing knowledge about an innovation.[2,12]

More recently, Finley-Zarse et al, also using Rogers' theory of diffusion as the framework, found an increase in the use of computer-based information sources among dental hygienists, including the Internet and computer databases, possibly consistent with increased computer use by the North American population in general.[16] Finley-Zarse et al examined information sources used by dental hygiene educators and practitioners, and found practitioners most frequently used, in descending order, CE courses, journals, asking a dentist, newsletters, and asking a dental hygiene colleague.

Ohrn et al studied research utilization among dental hygienists in Sweden, and found that reading research articles in professional journals was the most frequently reported research-related activity, followed by sharing research findings with colleagues.[28] Ohrn also found higher support for research use in public health settings, and suggested this may be related to the groups of dental hygienists working in such settings providing opportunity for collegial discussions, relating this to studies in nursing identifying the importance of interactivity for knowledge transfer.

Findings from a pilot study on research utilization in Alberta found that the top knowledge sources used by dental hygienists include: information learned about each patient/client as an individual; personal experience of dental hygiene patients/clients over time; and information obtained from attending inservices/conferences.[22] The finding of the top 2 knowledge sources was very interesting, as previous studies had not asked questions about these 2 sources. The least likely source used was "information I get by searching PubMed," a step that is consistent with recommended approaches to EBP. Findings such as these point to the need for empirical examination of how knowledge from research moves into dental hygiene practice, rather than reliance upon prescriptions for how to practice in an evidence based manner, especially when these prescriptive directions have not been empirically derived.

Discussion

In this paper, we consider diffusion of knowledge from research, or research findings, to be consistent with operationalization of a culture of evidence-based practice. Some models of EBP focus on methods by which an individual can seek an answer to a clinical question,[7-10] but these models do not address the social context in which research knowledge moves from one practitioner to another. Rogers' theory of diffusion takes this context and process of knowledge movement into consideration, and thus provides an excellent theoretical framework to study the movement of research knowledge into practice.

Challenges to moving knowledge from research into dental hygiene practice

Recommended approaches to evidence-based dental hygiene practice begin by developing a question to address the clinical problem or issue, searching for systematic reviews or research studies that may contain answers to the question, critically appraising the quality and appropriateness of the information retrieved, applying appropriate results into practice, and evaluating the results of the practice change.[7-10,29] However, this approach, a very linear and rational model, is prescriptive and simplistic, and does not acknowledge the complexity identified in studies of innovation diffusion and research utilization in other professions. These complexities include adequate skills for accessing and appraising evidence, access to evidence, the social context of practice, and authority over practice. It is also important to acknowledge that these models are not based on studies of how dental hygiene practitioners actually seek and incorporate new knowledge into practice. Such studies are necessary.

The findings of the dental hygiene information-seeking studies raise interesting questions about the current messages regarding EBP, oversimplified as "find it, critique it, do it," and their appropriateness given the inconsistency with dental Hygienists' demonstrated preferences for obtaining information for practice decisions.[15,16,22,26,27] A challenge for practitioners occurs when they believe that they should practice according to the latest evidence in order to be a good practitioner, but encounter barriers when trying to follow the currently popular approach being promoted in dental hygiene journals and CE sessions. It may be that a form of cognitive dissonance occurs when they continue to practice as they have been, while believing they should aspire to EBP, yet are unable to follow the supposedly simple steps for doing so. Understanding how dental hygienists prefer to obtain their information for practice can help evidence-based practice proponents promote methods that are consistent with existing behaviours and reduce the potential for cognitive dissonance. Diffusion theory can provide a framework for such studies.

Skills for evidence-based practice

Inherent in the linear rational model is an assumption that the necessary reviews or research are readily accessible by practitioners, that practitioners have the skills for searching and for critical appraisal, and that once a practice revision was identified as necessary, dental hygiene practitioners would have the authority to implement the change in practice. A study of dental hygiene programs found that teaching the necessary skills for EBP varied across dental hygiene programs[30] and that teaching of these skills were more likely to be found in baccalaureate curricula than in entry-to-practice associate degree or diploma-level programs.[31] Yet Chichester et al pointed out that often the application of this knowledge was not extended to making patient/client decisions at the chairside.[31]

Access to evidence

Access to research evidence, as per the EBP movement, poses a challenge for many dental hygienists. The EBP movement privileges quantitative methods, especially systematic reviews of randomized clinical trials. The type of research frequently conducted and published by dental hygienists, and found in dental hygiene journals, is more likely to be descriptive or correlational rather than experimental. This is partially connected to the politics of funding for research, ie, there is little funding available for dental hygienists and dental hygiene-related projects. Further, the limited access to graduate education and lack of doctoral programs means that there are few highly-qualified dental hygienist researchers with appropriate graduate education and research training to apply for funding, and to conduct and publish this research.

Practice and social context

A further challenge for dental hygienists is their relative isolation in their practice context - they may be the only dental hygienist working in the office, or other dental hygienist employees work on alternate days, making it difficult to achieve the social connections that facilitate information sharing. These influences make for a messy context in which to presuppose that the "find it, critique it, do it" model of EBP will just happen, even if the dental hygienist is completely sure what "it" is. These assumptions also are inconsistent with existing studies of information-seeking behaviours of dental hygienists.[15,16,22,26,27] Diffusion theory takes these influences into consideration.

Authority over practice

Changing dental hygiene practice in accordance with findings from recent research, as in an evidence-based approach to practice, assumes that the dental hygienist would have the authority to implement changes within the practice setting.[32] In the small-business setting of a dental office, there may be potential for conflict within the orientation for practice - is it to be a health service provider or a small business with a profit-driven orientation? While an uncomfortable thought, and one largely unacknowledged in the literature, the answer to this question could influence the choice of evidence to support decision-making in practice.

Dental offices can also be sites for interprofessional conflict[33,34] given their hierarchical structure with the dentist as employer and member of a profession that may consider itself superior to dental hygiene. There is a historical tradition of patriarchy, with dentistry once having had control over dental hygiene education, practice regulations, and control of practice settings through legislated supervision requirements. Many of these controls have disappeared over the years with trends toward self-regulation in professional practice, but dentists remain the primary employers of dental hygienists in North America, and perceive their education as superior for making decisions for practice.[34] It remains to be seen whether this increasing autonomy leads to more timely uptake of research findings into dental hygiene practice.

Movement of knowledge from research into practice is consistent with, and results in, EBP. Diffusion of innovations theory, where the innovation is the knowledge from research, provides a framework for the study of movement of research knowledge, such as the use of OCS in dental hygiene practice.

Summary

While Rogers' theory of diffusion of innovations holds some promise to study knowledge transfer in dental hygiene, there are some limitations to consider. One challenge to the use of Rogers' theory of diffusion of innovations is whether the findings of the research should be considered the innovation, or whether a communication vehicle, such as a clinical practice guideline, should be considered the innovation. Studying diffusion of the research findings poses problems with both access to, and understanding of, the research study itself by practitioners. Research findings are typically found in research journals that have limited circulation among practitioners, other than innovators, and are often written describing statistical tests and interpretations that are less meaningful to practitioners than to other researchers. These issues have been raised in studies of EBP with physicians,[35,36] yet some EBP messages to practitioners continue to promote actively seeking research studies.

Studying diffusion of translated research, such as a clinical practice guideline, holds more promise as it may be more accessible and understandable, but the use of clinical practice guidelines in dental hygiene, and in dentistry to an extent, is not yet common.[28] Use of practice guidelines is much more common in medicine and nursing, but not without limitations for success in uptake of recommendations.[37,38] Since dental hygiene practice contexts differ considerably from medicine and nursing, it is not easy to determine which lessons would transfer most readily. Studies of intentional diffusion of practice guidelines could use Rogers' theory to exploit knowledge of local social networks and contribute to changing current decision-making culture. However, there would be challenges to overcome in identifying local opinion leaders and the extent of networks, and the literature on the use of opinion leaders is not conclusive.

Similar to many health professionals, dental hygienists obtain much of their information about new interventions from CE courses and journal and magazine publications from their professional organizations. However, these mechanisms are unlikely to communicate the subjective evaluation information from a near-peer that is most influential in diffusion within a network, especially for those who are not at the leading edge.

Dental hygiene clinical practice does not have a facilitation role for communication of new research findings such as a Clinical Nurse Specialist or Clinical Nurse Educator, as found in nursing. This is a role that has potential for increasing research use,[39] however given the small-business setting of clinical dental practices, development of such a role in this environment is unlikely. However, municipal, regional, or state or provincial health authority dental programs may well be ideal locations for a newly developed role such as this. In particular, such dental programs would not have the potential conflict inherent in the market model of private practice.

The culture of dental hygiene has been evolving from a technical occupational model to a research and theory-oriented professional model,[40] but this evolution has been constrained by restrictive practice legislation and traditions of patriarchy and gender bias. These influences have in turn led to inter-professional conflict between dentistry and dental hygiene. Dental hygienists practice as employees of dentists, so the hierarchical relationship and patriarchal traditions exert both subtle and overt influences on dental Hygienists' decision-making behaviours. The influence of these conditions needs to be studied to determine how they would constrain or facilitate any strategies for knowledge transfer and implementation of changes for successful EBP.

Evidence-based practice involves locating and obtaining the best evidence and integrating it with clinical expertise and patient preferences, which may lead to changes and improvements in practice and health outcomes. Some possible interventions for the diffusion of evidence for practice, such as practice guidelines and the use of opinion leaders and facilitators, have been discussed. Studies are needed to determine which interventions will be most effective for implementing changes to move knowledge from research into dental hygiene practice. In particular, intervention studies related to increasing oral cancer screening (OCS), which has life-saving implications, should be a priority for dental hygienist researchers.

There is a need to increase the number of intervention studies that seek to move knowledge from research more rapidly into practice. The use of a theoretical framework will improve the quality of these studies, and Rogers' theory of diffusion of innovations holds some promise for this purpose. In our example, diffusion theory enabled us to systematically examine the movement of knowledge about OCS in the practice context of dental hygiene, and to identify its strengths and limitations for future use. The knowledge gained from this exercise can be useful in the design of theoretically-driven clinical trials to test interventions.

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Notes

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Advanced caries in a patient with a history of bariatric surgery

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Purpose. The rate of bariatric surgery in the United States has risen significantly in the past decade as the prevalence of extreme obesity continues to increase. Although bariatric surgery is an effective therapeutic modality for extreme obesity, it is associated with risk factors and select oral health conditions. This case study describes a patient with a significant increase in dental caries after having gastric bypass surgery. It was hypothesized that bariatric patients may be at an increased risk for caries due to the need for more frequent and prolonged meals throughout the day.

Methods. Dietary, bacterial, and salivary risk assessments were completed 5 years postsurgery. A 7-day food record was analyzed using Nutrition Calc Plus + 2.0 software and a plaque index was measured. In vitro test kits were used to evaluate the cariogenicity of the plaque as well as the quantity, quality, and buffering capacity of the patient's saliva. Clinical exams and dental radiographs were used to evaluate caries activity pre-and post-surgery.

Results. On average, the patient typically consumed fermentable carbohydrates 5 times per day with 12% of her calories from sucrose. The plaque index and cariogenicity were high. The patient demonstrated low salivary production with poor buffering capacity and viscous saliva. The caries activity was noticeably higher postsurgery versus presurgery.

Conclusion. The present case study supports the hypothesis that recommended postsurgical meal patterns may place the patient at an increased risk for dental caries, particularly in the presence of other risk factors. More research is needed to further evaluate this relationship.

Introduction

The rate of bariatric surgical procedures has increased significantly within the past decade. In fact, from 1998 to 2002, the number of gastric bypass surgeries has increased almost 6 fold.[1] This increase in popularity has been attributed to the current obesity epidemic, improvements in surgical techniques, and patient outcomes.[2] Although gastric bypass surgery is recognized as an effective treatment for severe obesity, it is associated with select nutritional and metabolic risk factors[3] as well as oral health conditions.[4,5,6]

This case study presents an adult female patient with a history of gastric bypass surgery who was treated for advanced caries at The Ohio State University Dental Clinic. Several caries risk factors were identified including the frequent consumption of refined carbohydrates and xerostomia. Standard dietary recommendations for bariatric patients include small frequent meals (4-6/day), thorough and slow chewing, and sipping of fluids throughout the day.[7] It was hypothesized

that the need for frequent and prolonged meal times increased the patient's risk for dental caries, particularly in the presence of xerostomia. Multiple risk factors were assessed including a 7-day diet record, cariogenicity of plaque, and the production and buffering capacity of saliva.[8] Outcomes for each risk factor will be described relative to the patient's preventive and restorative treatment plans.

Review of the Literature

Obesity is defined as an excess of body fat and is classified using the body mass index (BMI). The current classification system for obesity includes class I (30.0 - 34.9 BMI), class II (35.0 - 39.9 BMI), and class III (≥ 40 BMI).[9] Although the prevalence of obesity in general has increased dramatically among United States adults within the past few decades,[10] extreme obesity (≥ 40 BMI) has demonstrated the greatest increase compared to other classes.[11] It is currently estimated that class III obesity affects 1 in 20 Americans. Such findings represent a major public health concern since extreme obesity is associated with numerous comorbidities.[9]

Bariatric surgery is recommended for adult patients with class III obesity, and class II obesity with comorbidities, provided more conservative forms of treatment (ie, diet, exercise, behavioral and psychological) have not been successful.[12,13] Although experts agree that noninvasive weight loss programs should represent initial treatment for extreme obesity, the long-term effectiveness of such programs has proven unsuccessful for most patients.[14] Subsequently, bariatric surgery has become the "standard of care" for extreme obesity.[15,16] In fact, it is now recognized as the only therapeutic modality that results in sustained weight loss and improved comorbidities.[17]

The Roux-en-Y gastric bypass (RYGB) is the most common type of bariatric surgery performed in the United States. Weight loss via the RYGB procedure involves bypassing the distal stomach, duodenum, and proximal jejunum to reduce nutrient absorption and gastric volume[16] (Figure 1). With RYGB surgery, the stomach is reduced to a capacity of 15 to 50 mL, which requires patients to consume small frequent meals and sip liquids throughout the day.[3] The general guidelines include the consumption of foods and liquids at separate times, allowing at least 30 minutes apart from each other.[7] In addition, the consumption of small meals should take at least 20 minutes to allow satiation and to foster thorough chewing.[7,18] Although such meal patterns help to decrease post-surgical complications, the patterns do increase the frequency of substrate exposure which may present an increased risk for dental caries.[19,20] Dehydration is also a common concern due to the reduced gastric capacity.[18,21] Inadequate water intake contributes to xerostomia, which can increase caries activity.[8,22] To date there is very little research on the effect(s) of gastric bypass surgery on oral health. Heling et al (2006) evaluated dental complications among patients following gastric restrictive bariatric surgery (n=113) and found that 37% of patients reported eating more sweet foods, 20% reported improved oral hygiene, 34% reported greater frequency of dental visits and 37% reported increased hypersensitivity. Burge et al (1995) evaluated changes in patients' taste after RYGB (n=14) and noted an increased acuity for sweet and bitter tastes. Tichansky et al (2006) evaluated changes in taste among patients who underwent RYGB (n=82) and adjustable gastric banding (n=28) surgery. The investigators noted that the majority of subjects perceived a decrease in the intensity of taste and that subjects who underwent RYGB surgery perceived greater change in taste than the gastric banding subjects. To date, no known research has been conducted to examine the effect of diet/meal patterns among bariatric patients on the incidence of dental caries. This case study will examine risk factors for dental caries in a patient who underwent RYGB 5 years ago. The patient histories were reviewed and the risk assessments were completed in 2007.

Figures
Figure 1. Roux-en-Y gastric bypass
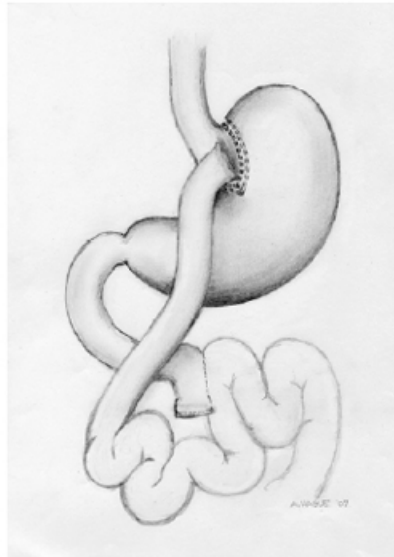

Patient History

Medical

The patient was a 48-year-old Caucasian female. The patient's height was 5'4" and her body weight was 220 pounds (BMI=38). The vital measurements were within normal limits. Her medical history included RYGB surgery, gallbladder removal, and gastritis. The bypass surgery was performed in 2002 to treat class III obesity (BMI=52). The patient reported taking no prescribed medications or vitamin/mineral supplements and indicated that her last physical exam was several years ago. She noted a history of vitamin B12 deficiency and lactose intolerance associated with the gastric bypass surgery. The patient also reported smoking approximately 2.5 packs of cigarettes per week for the past 9 years.

Dental

The patient has been a patient of record at The Ohio State University College of Dentistry since 1997. She initially presented to the OSU Emergency Dental Clinic in 1997 with a toothache due to a broken filling. All of her teeth were present at that time, except for third molars. A panoramic radiograph taken in 2001 showed two endodontically treated maxillary molars. Several class I and II amalgam restorations were noted in the posterior teeth and no restorations were present in the anterior teeth (Figure 2).

Figure 2: Panoramic radiograph 3/2001
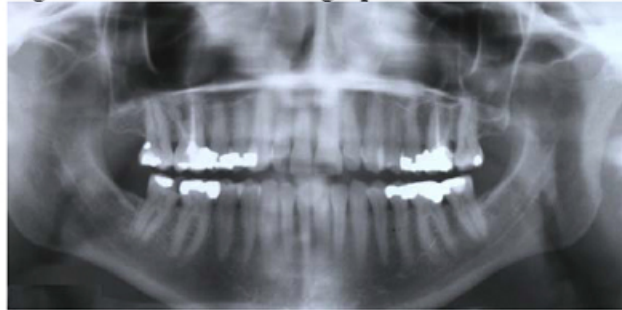
Due to financial constraints and anxiety associated with dental treatment, the patient initially sought dental care only when she experienced problems and/or discomfort. Between 1997 to 2005, the patient sought emergency treatment for several different conditions including reversible and irreversible pulpitis, a cracked tooth, acute apical periodontitis, and broken fillings. Although the patient did not maintain regular dental care for many years, regular care was initiated by the patient in 2005 and has been maintained since then.

Although the patient was diagnosed with numerous carious lesions from 1997 to 2007, the amount of decay, broken fillings, and the number of extractions (due to caries and/or non-restorability) increased significantly after the gastric bypass procedure in 2002. Prior to the bypass surgery (between 1997 to 2002), interproximal and/or recurrent decay was diagnosed on teeth numbers 3, 14, 19, and 31. After the bypass surgery (between 2002 to 2007), interproximal and/or cervical decay was diagnosed on teeth numbers 2, 4, 5, 11, 12, 15, 18, 19, 28, 29, and 30. Recurrent decay was diagnosed on teeth numbers 13 and 20. Bitewing radiographs taken one year apart depicted a significant increase in caries activity on teeth numbers 5 and 30. Additionally, tooth number 4 was extracted due to fracture (Figures 3 & 4).

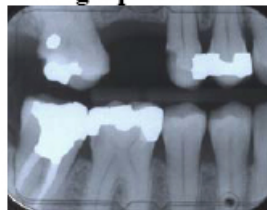**Figure 3: Bitewing radiograph 8/2004**

Figure 4: Bitewing radiograph 8/2005

A significant increase in the rate of decay was also observed in teeth numbers 19 and 20 in a 6-month period despite initiating a prescription strength fluoride toothpaste in October of 2005 (*Prevident 5000 Plus*, Colgate Oral Pharmaceuticals, NY) (Figures 5 & 6).

Figure 5: Periapical radiograph 8/2005

Figure 6: Periapical radiograph 2/2006

At the patient's next preventive recare appointment in August 2006, a restorative exam revealed decay on teeth numbers 2, 15, 19, 28, and 29. Nine months later, more decay was noted on teeth numbers 5, 11, and 19. All areas of decay were found on cervical and interproximal surfaces. To date, 8 teeth have been extracted due to caries and nonrestorability; 6 of them were extracted after the gastric bypass procedure (Figures 7 & 8). The patient reported no history of taste change or dental hypersensitivity after the gastric bypass procedure.

Figure 7: Maxillary arch 2/2007

Figure 8: Mandibular arch 2/2007

Risk Assessments

Diet

Prior to the gastric bypass procedure, the patient reported eating 3 main meals daily without regular snacks. The patient's meal pattern after the surgery included 3 small meals throughout the day with regular snacks in the morning and afternoon. Snack foods were typically fruit juice, bananas, muffins, crackers, beer, potato chips, pastry, and/or granola bars. The patient reported that she sipped fruit juice throughout the afternoon several times a week. Although her meal size decreased dramatically, the patient reported no significant difference in the type of foods consumed pre- and post-surgery-once she advanced to solid foods-except for high fat meats which she found hard to digest postsurgery.

The patient completed a 7-day food record, which was analyzed for nutrient content using Nutrition Calc Plus + 2.0 software (McGraw Hill Companies, Dubuque, Iowa). Her caloric distribution was 14% protein, 45% carbohydrate, 36% total fat, and 5% alcohol based on an average intake of 2067 kcal. The patient's water and total carbohydrate intake were less than adequate at 60% and 67% of recommended levels, respectively. Although her total carbohydrate intake was low (235 g), her daily average sugar intake was relatively high (64 g) and represented 12% of her total calories. The patient consumed, on average, an adequate number of servings for grains, meat, and beans but consumed less than the recommended number of servings for milk (30%), vegetable (49%), and fruit (60%).

Although the patient's oral soft tissues were normal in appearance, the patient was referred to her physician to evaluate a possible nutritional deficiency due to her high risk status and her lapse in medical care. A biochemical assessment revealed a vitamin B12 and iron deficiency, which was treated via supplementation along with a daily vitamin/mineral supplement. Because of her daily vitamin and mineral supplements, the analysis showed the patient's intake was at or above the recommended amount for vitamins and minerals with the exception of calcium (67%), magnesium (53%), and potassium (36%).

Plaque

The patient presented with generalized plaque-induced mild gingivitis with localized moderate periodontitis and minimal bleeding on probing. The patient's plaque index was evaluated using a 2-tone disclosing solution (*Plaque-Check+pH*, GC America Inc., Alsip, Ill) to determine plaque maturity. The plaque index before brushing was 64%. Mature plaque (present for more than 48 hours) was found generalized in the cervical area. Newly formed plaque was found generalized on interproximal surfaces. The patient's oral hygiene regimen included brushing 2 to 3 times per day with a fluoridated toothpaste and flossing 1 time per day. An in vitro test kit (*Plaque-Check+pH*, GC America Inc., Alsip, Ill) was used to evaluate the acidogenicity of the patient's plaque. The test assessed total acid production using a sugar substrate and a green pH indicator. Research for this product has demonstrated a significant correlation between cariogenic bacteria in dental plaque and its acidogenicity.[23] The plaque sample was evaluated based on the manufacturer's instructions. A sample was harvested from the proximal surface of a posterior tooth. The sample site was dried with an air syringe to avoid contamination with saliva. The plaque sample was subjected to a sucrose challenge for one second and allowed to ferment for 5 minutes. The green pH indicator turned a vivid red within 5 minutes indicating high cariogenicity (ie, pH of 5.0 to 5.8) of the plaque sample.

Saliva

An in vitro salivary test was used to evaluate the quantity, quality, pH, and buffering capacity of the patient's saliva (Saliva-Check, GC America Inc., Alsip, Ill). The saliva sample was evaluated based on the manufacturer's instructions. The patient was asked not to smoke, consume food or drink, brush her teeth, or use a mouth wash for at least one hour prior to her appointment. The saliva sample was collected at the beginning of the appointment to prevent confounding results. The patient's saliva production was low at rest (>60 seconds for visible production) and at stimulation (.62 mL/min) via visual assessment of secretions from the mandibular labial glands and from chewing paraffin wax, respectively. The pooled saliva and stimulated saliva were collected separately to measure the patient's resting and stimulated pH. Test strips were placed in each sample for 10 seconds and evaluated for color change based on the kit's reference chart. The pH of the sample at rest and at stimulation were relatively low at 5.6 and 6.2, respectively (range=5.0 to 7.8). The ability of the

saliva to neutralize different acid concentrations was also determined via a test strip. The buffer test score indicated a very low buffering ability of the saliva with a score of 2 (range=0 to 12). The viscosity of the saliva was frothy/bubbly, based on visual assessment in the oral cavity. The patient reported a feeling of chronic "dry mouth" since 2005 and noted that it often interfered with chewing. To ease the symptoms, the patient frequently used an artificial saliva spray, a piece of candy, or a cough drop.

Treatment Plan

Preventive

To decrease the patient's risk for caries, recommendations were made to: a) increase complex carbohydrates and reduce the consumption of simple sugars throughout the day;[20] b) include cariostatic food factors such as proteins, cheeses, and phytates (phosphorus-containing compounds found in the outer husks of cereal grains) particularly when consuming acidogenic foods;[19] c) increase water consumption; d) stimulate salivary flow via fibrous foods;[20] e) increase the frequency of brushing and flossing after meals/snacks; f) continue the daily use of 1.1% sodium fluoride toothpaste (Prevident 5000 Plus, Colgate Oral Pharmaceuticals, NY); and g) maintain a 4-month recare schedule to monitor for evidence of remineralization or further demineralization.[24]

Restorative

The patient's restorative treatment plan from 2005 was modified in accordance with the detection of new carious lesions, additional tooth fractures, and extractions. This modified treatment plan took into account the patient's dental history, current caries risk level, prevention of disease, and fracture of weakened tooth structure.[24,25] The working treatment plan included: a) extractions for teeth numbers 4, 12, 13, 30, and 31; b) root canal therapy for tooth number 20; c) amalgam or composite fillings on the crowns and/or root surfaces of teeth numbers 2, 5, 15, 19, 28, and 29; d) crowns for teeth numbers 19 and 20; and e) removable partial dentures for the maxillary and mandibular arches. The established treatment plan was completed with the exception of the crown for tooth number 19 and the mandibular partial denture, which was scheduled for a later time.

Discussion

The most significant dietary factor in the etiology of caries is the frequent consumption of sugar and other fermentable carbohydrates.[20,26] Although the patient reported no dramatic change in the types of foods consumed before and after the bypass surgery, there was a difference in the pattern of foods/beverages consumed following the procedure. The primary difference included 5 meals/snacks daily versus 3 main meals. Meals/snacks included cariogenic foods such as bananas, muffins, crackers, potato chips, beer, granola bars, pastries, and chronic sipping of fruit juice.[19,20] Such foods are reflective of the patient's high average sugar intake (12%). Ingesting more than 10% of calories as sugar and consuming fermentable carbohydrates more than 4 times a day represent an increased risk for dental caries.[27] Since the dietary "rules" for bariatric patients include eating 4 to 6 times per day[7,28] and sipping fluids frequently throughout the day to prevent dehydration,[7] the risk for caries may be increased if fermentable carbohydrates are routinely consumed.

Lactose intolerance is a common condition among bariatric patients due to the diminished production of lactase. The dietary recommendations for this condition include avoidance of cow's milk.[7] Postsurgically, the patient reported suffering from lactose intolerance. Consequently, her intake of dairy products and calcium was low at 30% and 67% of her recommended amounts, respectively. Milk-derived factors such as calcium phosphate and casein are considered anticariogenic since they appear to protect the enamel against demineralization.[20] Reduced exposure to these protective effects may have added to the patient's risk of decalcification.

Dental caries is a multifactorial disease that includes not only dietary factors but also host and bacterial factors.[20] The patient's low salivary production and buffering capacity represent significant risk factors for dental caries.[8,27] Factors that may have contributed to the patient's low salivary production and buffering capacity included her low water consumption (60% of recommended) and cigarette use.[29] Although it is unclear why the patient first recognized the signs of dryness approximately 3 years after gastric bypass surgery, it is probable that xerostomia contributed to the increased rate of decay due to diminished natural cleansing of the oral cavity and buffering of plaque acids.30 This risk was compounded by the frequent use of regular cough drops and candy to ease the symptoms of xerostomia. The patient also demonstrated a high plaque index (64%) with high cariogenicity. Five minutes after a sucrose challenge, the plaque sample pH was within the range of decalcification at 5.0 to 5.8. Such cariogenic plaque represents an increased risk for dental caries when the frequency of fermentable carbohydrate consumption is increased.[19]

Dietary recommendations for the patient included reducing sucrose consumption to less than 10% of calories and selecting more nonfermentable carbohydrate snacks. Water was recommended as a substitute to sipping fruit juice to help reduce substrate exposure, increase hydration, and help ease the symptoms of xerostomia.[30] Based on MyPyramid, at least 5 servings of whole fruit and vegetables were recommended to increase nutrient intake and stimulate salivary flow via fibrous foods.[31] To help increase the patient's calcium intake, 3 daily servings of dairy products with low lactose (eg, cheese and yogurt) were recommended. An increase in dairy products may contribute to caries protection and also help reduce the risk of osteoporosis, which represents a significant risk among bariatric patients.[3]

Conclustion

The likelihood that a dental health professional will provide care for a patient with a history of bariatric surgery will increase as the prevalence of extreme obesity continues to increase in the United States.[32] Subsequently, there is a need to better understand oral health implications associated with bariatric surgery. The present case study lends support to the hypothesis that bariatric patients may be at an increased risk for dental caries due to a smaller stomach volume and the need for smaller, more frequent meals/snacks throughout the day. The increased risk of dehydration and lactose intolerance among bariatric patients may also contribute to caries activity due to the occurrence of xerostomia and reduced exposure to anticariogenic factors in milk. More research is needed with an adequate sample size and controls for multiple risk factors to gain a better understanding of the relationship between recommended meal patterns for bariatric patients and dental caries risk. Further supportive evidence would stress the need for more preventive dental care among this population. Preoperative nutritional counseling and oral hygiene instruction may prove especially beneficial in helping to reduce the risk of dental caries. The delivery of preventive care to help the patient maintain a healthy dentition and good chewing function is especially important in a population already at nutritional risk.

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Notes

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