Journal of Dental Hygiene

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STATEMENT OF PURPOSE

The *Journal of Dental Hygiene* is the refereed, scientific publication of the American Dental Hygienists' Association. It promotes the publication of original research related to the profession, the education, and the practice of dental hygiene. The journal supports the development and dissemination of a dental hygiene body of knowledge through scientific inquiry in basic, applied, and clinical research.

SUBSCRIPTIONS

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SUBMISSIONS

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Inside

Features

Editorial

Rebecca S. Wilder, RDH, BS, MS

Elevating Dental Hygiene Scholarship in the Future

As we embark upon a monumental year at the American Dental Hygienists' Association, I pause to think about the future of research and scholarship within the profession. Although we have already started the celebration of 100 years of the ADHA, we will formally have a "big party" at the 2013 Center for Lifelong Learning. Research will be part of what we honor about our progress. Many more dental hygienists are involved in research and scholarly activity than just a few years ago. More changes are anticipated for the future as we begin to discuss the possibility of doctoral education in dental hygiene. I remember when we had only a few graduate programs in dental hygiene. Now, we number about 20+ programs, most of them specifically in dental hygiene.

We must have more dental hygienists pursuing graduate degrees if we are to continue the momentum of scholarship in our profession. However, a recent study by Boyd and Bailey found that fear of thesis research is a significant barrier to dental hygienists as they consider graduate studies.[1] This finding is not surprising as most dental hygiene students have little scientific writing experience and few are exposed to the process of research during their undergraduate education. I find this same fear in my own graduate students when they matriculate into our masters program. Once they realize that they will be provided with ideas for research or perhaps be included in an ongoing study, they start to experience less fear. When they discover that they will have a thesis committee who will mentor them and guide them through the process, they start to get encouraged. By the time they complete the data collection, analyze the results, defend the thesis, present the project at a scientific meeting and write it up and submit it to the graduate school, they are delighted! And when they finally see their paper in print in a scientific journal, they are ecstatic, proud beyond belief... and ready to do more! Writing the thesis research and publishing it in a peer reviewed scientific journal like the Journal of Dental Hygiene is key to moving our profession forward and cultivating a new generation of scholars.

Another trend we are observing is the rise in numbers of dental hygienists who are pursuing doctoral degrees. I anticipate that we will have a doctoral program in dental hygiene in the near future. The advantage of doctoral programs is that they have the potential to educate professionals who have a solid base in scientific inquiry and thus can contribute to the scholarly process of the profession. My hope is that the doctoral programs in dental hygiene will have rigorous requirements for research and writing, culminating in a dissertation that is later formatted for publication in our scientific journal!

As we celebrate 100 years of the ADHA, we realize how far we have come in a short 100 years and where we want to go in the future. A profession is defined by having its own body of knowledge that culminates in dissemination to the world. You have a wonderful resource in the Journal of Dental Hygiene. It is a visible display of our research and scholarship and it is growing each year! I will close with a question for you: How will you contribute to the growth of scholarship for the profession?

Sincerely,

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

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Linking Research to Clinical Practice

Non–Fluoride Caries–Preventive Agents

Denise M. Bowen, RDH, MS

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.

Rethman MP, Beltran–Aguilar ED, Billings RJ, et al. Nonfluoride caries–preventive agents: executive summary of evidence–based clinical recommendations. J Am Dent Assoc. 2011;142(9):1065–1071.

Background: In this article, the authors present evidence–based clinical recommendations regarding the use of nonfluoride caries preventive agents. The recommendations were developed by an expert panel convened by the American Dental Association (ADA) Council on Scientific Affairs. The panel addressed several questions regarding the efficacy of non–fluoride agents in reducing the incidence of caries and arresting or reversing the progression of caries.

Types of Studies Reviewed: A panel of experts convened by the ADA Council on Scientific Affairs, in collaboration with ADA Division of Science staff, conducted a MEDLINE search to identify all randomized and non–randomized clinical studies regarding the use of non–fluoride caries–preventive agents.

Results: The panel reviewed evidence from 50 randomized controlled trials and 15 non–randomized studies to assess the efficacy of various non–fluoride caries–preventive agents.

Clinical Implications: The panel concluded that certain non–fluoride agents may provide some benefit as adjunctive therapies in children and adults at higher risk of developing caries. These recommendations are presented as a resource for dentists to consider in the clinical decision–making process. As part of the evidence based approach to care, these clinical recommendations should be integrated with the practitioner's professional judgment and the patient's needs and preferences.

Commentary

An expert panel convened by the ADA conducted a systematic review to examine studies of non–fluoride agents in caries prevention and management. The research questions addressed whether non–fluoride agents could reduce incidence, arrest or reverse caries in the general population or in individuals at high caries risk. After identifying inclusion criteria for high quality studies, reviewing 2,697 articles from 1966 to 2010 and updating them through March 2011, the panel included 65 articles in its systematic review. Meta–analyses were performed when adequate numbers of similar studies were available to combine data and statistically control for effect size. In other words, studies with greater numbers of subjects and more statistical power were weighted more heavily than those with smaller samples.

The panel reviewed randomized clinical trials (RCTs, n=9) and non–randomized clinical studies (n=6) to evaluate the effectiveness of sucrose–free polyol (e.g., sugar alcohols such as xylitol and sorbitol) chewing gums in general populations. Meta–analysis found a statistically significant reduction in coronal caries in permanent teeth with use of xylitol gum (or combined polyol gum with xylitol and other sugar alcohols) compared with no gum or chewing gum with sorbitol. In children, a marginal reduction in caries incidence was found. Risk of choking in young children should be considered, and chewing gum should only be recommended for children over age 5 without neurological or swallowing problems. Xylitol–containing lozenges or hard candy were found to reduce incidence of coronal caries, although the evidence was not as strong as it was for gum. A dose of 5

to 8 grams/day divided into 2 or 3 doses (e.g., after meals) was suggested for maximum clinical benefits. Most chewing gums marketed in the U.S. with xylitol contain 0.50 to 0.72 grams per dose, meaning one would need to chew 7 to 12 pieces of gum daily, or 3 to 4 pieces 2 to 3 times a day. Chewing gum available in smaller pieces has an advantage over larger pieces because 3 pieces per dose are more practical to chew. Even with smaller units, that dosage is difficult to attain on a daily basis. Practitioners recommending xylitol gum or lozenges should be aware that large doses have been linked to adverse gastrointestinal effects.

When examining studies of antimicrobial agents in caries prevention, the panel concluded there is not sufficient evidence to support triclosan or iodine. Most of the studies reviewed by the panel were related to chlorhexidine (CHX) varnish or mouth rinses, however, neither of these products has been approved in the U.S. by the Food and Drug Administration for use in caries prevention. The products marketed in the U.S. include 1:1 chlorhexidine–thymol varnish and 0.12% chlorhexidine gluconate mouthrinse. Insufficient evidence is available to recommend use of CHX gels available outside of the U.S. for caries prevention in adults or children.

Evidence did not adequately support use of 10 to 40% CHX varnish for prevention of coronal caries in children or root caries in adults. However, when evaluating studies (n=6) of chlorhexidine–thymol varnish, the panel concluded a 1:1 mixture of chlorhexidine/thymol varnish applied every 3 months reduces the incidence of root caries in adults and elderly.

When evaluating 4 studies of 0.12% CHX mouth rinse in reducing caries in children and adults and 2 studies evaluating root caries in adults and older adults, the panel concluded that CHX rinse alone or in combination with fluoride does not reduce caries incidence in any of these groups. The panel concluded that CHX rinses should not be recommended as a non–fluoride therapy for reducing caries incidence, arresting or reversing caries. Since that time, however, a longitudinal RCT has been published to support combined daily 0.12% CHX rinse and fluoride therapy in adults with high caries risk. A discussion of this subsequent study follows.

The panel also evaluated studies (n=9) of calcium and/or phosphate agents with and without casein derivatives for caries prevention. It found that published clinical trials do not provide sufficient evidence that use of these agents lowers incidence of either coronal or root caries.

The authors remind clinicians that caries risk assessment, patient motivation and readiness for change, oral health literacy, ability to accept and complete a recommended treatment plan and compliance all affect the outcome of a caries management care plan. Further, good evidence supports professional and home fluoride products including fluoridated toothpastes. Fluoride therapy and dental sealants remain the primary interventions for preventing caries, and clinicians should follow published evidence–based guidelines for these modalities.[1,2]

Featherstone JD, White JM, Hoover CI, et al. A randomized clinical trial of anticaries therapies targeted according to risk assessment (caries management by risk assessment). Caries Res. 2012;46(2):118–129.

This randomized parallel group clinical trial assessed whether combined antibacterial and fluoride therapy benefits the balance between caries pathological and protective factors. Eligible, enrolled adults (n=231), with 1 to 7 baseline cavitated teeth, attending a dental school clinic were randomly assigned to a control or intervention group. Salivary mutans streptococci (MS), lactobacilli (LB), fluoride level and resulting caries risk status (low or high) assays were determined at baseline and every 6 months. After baseline, all cavitated teeth were restored. An examiner masked to group conducted caries exams at baseline and 2 years after completing restorations. The intervention group used fluoride dentifrice (1,100 ppm fluoride as NaF), 0.12% chlorhexidine gluconate rinse based upon bacterial challenge (MS and LB) and 0.05% NaF rinse based upon salivary fluoride. For the primary outcome, mean caries increment, no statistically significant difference was observed (24% difference between control and intervention groups, p=0.101). However, the supplemental adjusted zero–inflated Poisson caries increment (change in decayed, missing and filled surfaces, DMFS) model showed the intervention group had a statistically, significantly lower mean than the control group (24%, p=0.020). Overall, caries risk reduced significantly in intervention versus control over 2 years (baseline adjusted generalized linear mixed models odds ratio, (aOR=3.45; 95% CI: 1.67, 7.13). Change in MS bacterial challenge differed significantly between groups (aOR=6.70; 95% CI: 2.96, 15.13) but not for LB or fluoride. Targeted antibacterial and fluoride therapy based on salivary microbial and fluoride levels favorably altered the balance between pathological and protective caries risk factors.

Commentary

To date, very few randomized clinical trials have been conducted to evaluate use of a combination of fluoride therapy and 0.12% CHX gluconate rinse for caries prevention. Most of the published research related to CHX rinses has been related to the antimicrobial effect on gingivitis, and many studies have shown that CHX is an effective anti–gingivitis agent when used twice a day as directed. The objective of this study was to provide clinical evidence that a valid caries risk assessment combined with aggressive caries prevention methods and conservative dental restorations would result in a lower caries increment compared to not using this combined approach in adults. The hypothesis was that "caries management and conservative restorative treatment based on caries risk status (low or high) would significantly reduce 2–year caries increment compared to traditional, non–risk–based dental treatment."

Both groups (n=231) initially received a dental examination including radiographs and DMFS to confirm presence of 1 to 7 active caries lesions as well as a salivary assay analysis for salivary MS, LB and fluoride level to determine caries risk status (low/high). The examiner performing caries examinations before and after treatment was blinded to group assignment to reduce examiner–related bias. The control group received traditional treatment plans for restorative care and follow up. The intervention subjects were classified as high or low caries risk. Intervention group participants received information about their salivary analysis and their low or high caries risk status based on salivary analyses. Treatment plans included minimally invasive restorative care and sealants for all, as well as additional antibacterial/fluoride therapy for those in the high caries risk group. Subjects in both groups were instructed to reduce daily carbohydrate intake and brush daily with the 1,100 ppm sodium fluoride (NaF) dentifrice provided. Some subjects in both groups changed toothpastes over the 2 year study period, however, patient–selected dentifrices were similar. High caries risk subjects in the intervention group received an in–office 1.1% NaF treatment, instructions to use a 0.05% (225 ppm) NaF fluoride mouth rinse once daily, similar to most over–the–counter fluoride rinses sold in the U.S. and instructions to use a 0.12% CHX rinse. The protocol for the CHX rinse was once daily for 3 months through the restorative phase, followed by once daily for the first week of each month thereafter. This recommendation differs from the twice daily recommendation for gingivitis prevention and treatment. Compliance and self–recording of rinse use was encouraged and monitored. All subjects were recalled every

6 months for salivary assays and needed restorative care, and followed for 2 years. At the end of that period, final dental exams with radiographs and DMFS and salivary assays were performed. The authors defined the primary outcome measure as the caries increment (change in number of DMFS). Secondary measures included caries incidence (new), changes in decayed, missing and filled teeth, changes in number of decayed teeth (DT) or surfaces (DS), caries risk, salivary MS and LB levels and fluoride levels in saliva. Statistical analysis found no significant difference in baseline demographics or clinical characteristics of the groups, and demographics of those subjects who completed the study were comparable (control group=52, intervention subjects=60). Most attrition occurred early in the study because patients were unable to pay for and complete initial restorative treatment plans.

This study was designed to evaluate an aggressive caries management program with conservative restorative dental care based on caries risk assessment. This protocol has been suggested for some time, however, practitioners have been slow to adopt it. The complexity of this research protocol, especially for the intervention group, reflects the complexity of the suggested clinical approach to caries prevention, and that factor might be affecting adoption in practice. The authors of this manuscript stated that no practical caries risk assessment plan has been proven effective using a prescribed caries management plan. Nonetheless, a new approach to caries management in adults and children is needed. Although prevalence and incidence has been reduced since the 1960s, dental caries remains a major health problem. The status quo has not been shown to be an effective means of eradicating the disease. These authors have suggested, "With accurate risk assessment, noninvasive care modalities, including chlorhexidine antimicrobial and fluoride rinses, can be applied with confidence and invasive restorative procedures (if needed) can be more conservative, preserving tooth structure and better benefiting patient oral health."

Results showed lower caries increments (DMFS, DT, DS, DMFT) in the intervention group compared to the control group, although not statistically significant. No statistically significant differences between the groups were found in caries incidence over the 2 year study period. These results may have been impacted statistically by the fact that the distribution of scores was skewed by many 0 scores. A statistical model was used to adjust for this skewing by analyzing only the non–negative scores. This analysis indicated the

intervention group had a statistically significant 24% greater reduction in DMFS than the control group. A statistically significant reduction in caries risk and MS levels also favored the intervention group, however, no significant difference was found in salivary LB or fluoride levels. In short, the intervention resulted in a significantly lower percentage of subjects at high risk and high/medium bacterial challenge during the study period. Caries removal and dental restorations alone did not significantly change the MS bacterial challenge, caries increment or risk in either the control group or intervention subjects group. The use of an antimicrobial rinse, CHX, in conjunction with the dental treatment plan, did reduce the bacterial challenge by MS. The authors emphasized the need for combined fluoride therapy to remineralize tooth surfaces.

These authors based this study on the current approach to caries management by risk assessment which advocates improving the balance between protective factors (fluoride, calcium, phosphate, saliva and antibacterial agents) and pathological factors (cariogenic bacteria, dietary habits – especially frequent ingestion of fermentable carbohydrates and lack of saliva). Stepping up the caries risk assessment and management approach to include aggressive caries prevention methods in adults at high risk may be warranted based on the results of this randomized clinical trial.

The Bottom Line

Each of these studies addressed recommendations for use of CHX gluconate in an effective caries management program. The findings and conclusions do not agree because the first study was a systematic review and meta–analyses of studies conducted from 1966 to 2011. Results of the second study were published in 2012, so they were not a part of the findings of the systematic review. The new information must be confirmed through other studies but provides some evidence about how a CHX mouth rinse might be used to reduce caries risk in a comprehensive caries management program.

Both of these studies provide clarification regarding the value of nonfluoride agents in caries management. Based on the findings of one or both of these studies, the following conclusions can be drawn:

- For adults, xylitol chewing gum can be effective in reducing coronal caries with correct dosage. Adults can be advised to use xylitol

gum for 10 to 20 minutes after meals.
- The effect of xylitol chewing gum in children shows only a marginal reduction in caries. The risk of choking in young children should be considered, and chewing gum should only be recommended for children over age 5 without neurological or swallowing problems.
- There is not sufficient evidence to indicate that gum with other types of alcohol sugars (e.g., sorbitol) is effective in caries prevention and control.
- There is no evidence to show that CHX gel or 10 to 40% varnish prevents coronal or root caries in adults or children.
- There is evidence that CHX–thymol varnish applied every 3 months can prevent root caries in adults and older adults.
- There are conflicting views regarding use of a 0.12% CHX rinse for caries management. An ADA panel recommended in 2011 that clinicians avoid prescribing this rinse for caries prevention and control, however, a 2012 longitudinal RCT showed 0.12% CHX rinse plus fluoride therapy can be effective in reducing caries, decreasing MS levels and reducing caries risk in adults at high risk for caries. The latter finding was based on once daily CHX rinsing in combination with professional NaF application and daily use of fluoride toothpaste and an OTC fluoride rinse. Clinicians may recommend this protocol as a part of a comprehensive treatment plan including dietary advice to reduce carbohydrate intake, sealants and conservative restorative care but should avoid recommending CHX rinse alone for caries management.
- There is insufficient evidence from published clinical trials to support the use of calcium and/or phosphate agents with or without casein derivatives for prevention of coronal or root caries.

Summary

Evidence supports fluoride therapy and sealants for caries prevention and management. Evidence regarding non–fluoride agents indicates that xylitol chewing gum used after meals also can be effective in reducing coronal caries in adults and, to a lesser extent, children. Evidence does not support use of CHX gel or varnishes, however, CHX–thymol varnish can be applied 3 times a year to prevent root caries in adults and elders. There are conflicting views regarding use of 0.12% CHX rinse in combination with fluoride therapy for caries management. Recent findings indicate that use of a CHX rinse, in conjunction with caries risk assessment, fluoride therapy and a conserva-

tive dental treatment plan, reduced MS bacterial levels, caries increment (based on non–negative scores) and caries risk in adults with high caries risk. Insufficient evidence is available to recommend use of calcium and/or phosphate agents for caries management. Dental hygienists need to address caries risk based on a multi–pronged approach, especially in patients at high risk.

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Advancing Our Profession: Are Higher Educational Standards the Answer?

Erin S. Boyleston, RDH, MS; Marie A. Collins, RDH, EdD

Introduction

A profession is defined as an entity that continuously enlarges its body of knowledge, functions autonomously in formulation of policy and maintains high standards of achievement and conduct.[1] Educational models in health care have changed drastically as professions mature. As our knowledge base expands, our expectations for highly educated health care professionals continue to increase as well. Standards for entry into practice need to reflect the depth and rigor of programs. The purpose of this manuscript is to investigate how the professions of physical therapy, occupational therapy, physician assistant, nursing and respiratory therapy have advanced their educational models for entry into practice and to recommend how dental hygiene can integrate similar models to advance the profession.

In June 2002, the Institute of Medicine (IOM) organized a multidisciplinary summit (the Committee on Health Professions Education) to address concerns that health professionals were not adequately prepared to meet the needs of the patient and the requirements of the changing health care system.[2] Participants included representatives from allied health, nursing, medical and pharmacological educators and students, health professional and industry association representatives, regulators and representatives of certifying organizations, providers, consumers and influential policy makers. The committee was tasked with developing strategies for restructuring clinical education across the full continuum of education. The resulting report, Health Professions Education: A Bridge to Quality[2] is applicable to all clinicians, regardless of discipline. The vi-

sion that emerged from the summit was stated as "All health professionals should be educated to deliver patient–centered care as members of an interdisciplinary team, emphasizing evidence–based practice, quality improvement approaches and informatics."

Core competencies were identified by the IOM that validate the rationale for advancing the education of entry–level clinicians beyond technical training. This concept has been implemented by professions such as physical therapy, occupational therapy, physician assistant, nursing and respiratory therapy as they advanced their educational models. The following describes the professions and how they have reformed their entry to practice models.

Physical Therapy

The American Physical Therapy Association (APTA) defines physical therapists as highly–edu-

Abstract

Purpose: Educational models in health care professions have changed drastically since on–the–job training models. The purpose of this manuscript was to investigate how the professions of physical therapy, occupational therapy, physician assistant, nursing and respiratory therapy have advanced their educational models for entry into practice and to recommend how dental hygiene can integrate similar models to advance the profession. The recommendations are to create an accreditation council for dental hygiene education and to mandate articulation agreements for baccalaureate degree completion in developing and existing programs. Dental hygiene must continue on the path to advance our profession and glean lessons from other health professions.

Keywords: Allied Health Occupations, dental hygiene, education, baccalaureate

This study supports the NDHRA priority area, **Professional Education and Development:** Investigate how other health professions have established the master's and doctoral levels of education as their entry level into practice.

cated, licensed health care professionals who treat individuals with health–related conditions, illnesses or injuries that limit their abilities to move and perform functional activities in their daily lives. Additionally, they teach patients how to prevent the loss of mobility or manage their condition by developing programs for healthier and more active lifestyles.[3]

The profession of physical therapy developed during the latter part of the 19th century due to the crippling effects of the polio epidemic (1894 to 1916) and the vast number of wounded soldiers returning from World War I (1914 to 1919). The majority of these early education programs awarded certificates, were only 3 to 6 months in length and required students to have either a prior degree in physical education or high academic standing. Graduates who provided service in the military were called "Reconstruction Aides" and those in civilian roles were called "Physiotherapy Technicians" or "Physical Therapy Aides."[4–6]

As the demand for physical therapists grew, the delivery of their services also expanded beyond the traditional hospital setting to private homes, schools and nursing homes. Many argued that the technical training alone was no longer sufficient to prepare graduates for the complex medical needs of the population. The first standards of the profession were established in 1928 by the American Physiotherapy Association, a precursor to the APTA. Accreditation was later transferred to the American Medical Association (AMA) due to APTA's limited resources and inability to enforce educational standards. As a benchmark for developing programs, the AMA established accreditation guidelines in the 1936 publication, The Essentials for an Acceptable School for Physical Therapy Technicians. Entry into the 12 to 24 month physical therapy programs required a minimum of 60 college credits or a 2 year degree in nursing or physical education. Throughout the 1950s, there was a proliferation in the number of baccalaureate programs and a reduction in certificate programs. By 1960, the minimum educational qualification was elevated to the baccalaureate degree level. A resolution proposed in 1979 required a post–baccalaureate entry–level degree but was met with resistance and later abandoned in 1988. The Commission on Accreditation in Physical Therapy Education (CAPTE) assumed sole responsibility for accreditation of physical therapy education programs in 1983 and continues in this role today. CAPTE is comprised of a 29 member commission with representation from physical therapy educators who are basic scientists, curriculum specialists and academic administrators, physical thera-

py clinicians and clinical educators, administrators from institutions of higher education and public representatives.[7]

Since 2002, the entry into practice degree in physical therapy has been the master's degree. As of 2010, there are 213 accredited entry–level programs in the U.S., of which 7 grant a master's degree and 206 grant a doctorate degree.[8] Regardless of academic degree, to obtain a license to practice, students must graduate from an accredited program, successfully pass the National Physical Therapy Examination (NPTE) and fulfill any additional state or territory–specific requirements.

Vision 2020 is the APTA's plan for the future of physical therapy, which states: "By 2020, physical therapy will be provided by physical therapists who are doctors of physical therapy, recognized by consumers and other health care professionals as the practitioners of choice to whom consumers have direct access for the diagnosis of, interventions for, and prevention of impairments, activity limitations, participation restrictions and environmental barriers related to movement, function and health."[9] The 6 specific elements of the Vision include autonomous practice, direct access, doctor of physical therapy, evidence–based practice, practitioner of choice and professionalism.[9] This is consistent with CAPTE's adoption of advancing the entry–level degree to the doctoral level by December 31, 2015.[7] An Education Strategic Plan (2006 to 2020) to accomplish Vision 2020 has been outlined by APTA in 18 goal statements.[10]

Occupational Therapy

The American Occupational Therapy Association, Inc. (AOTA) defines occupational therapists as health care professionals who assist individuals or groups with everyday life activities (occupations) for the purpose of participation in roles and situations in home, school, workplace, community and other settings. Occupational therapy services are provided for the purpose of promoting health and wellness and to those who have or are at risk for developing an illness, injury, disease, disorder, condition, impairment, disability, activity limitation or participation restriction. Occupational therapy addresses the physical, cognitive, psychosocial, sensory and other aspects of performance in a variety of contexts to support engagement in everyday life activities that affect health, well–being and quality of life.[11]

Similar to the physical therapists of the time, occupational therapists also filled the role of Re-

construction Aides assisting injured soldiers after World War I.[11,12] In 1917, occupational therapy established its first professional association, the National Society for the Promotion of Occupational Therapy (NSPOT), which later changed its name in 1921 to the American Occupational Therapy Association. AOTA's leadership helped create professional–level courses of study in colleges and universities throughout the U.S. to assure a high quality of practitioner in the field. By 1931, the first official educational standards for occupational therapists were published. In 1933, a collaborative effort between AOTA and the AMA resulted in the development and improvement of education programs for occupational therapy. The Essentials of an Acceptable School of Occupational Therapy was the guideline established in 1935, representing the first cooperative accreditation activity by the AMA. Occupational therapy programs are accredited by the Accreditation Council for Occupational Therapy Education (ACOTE) of the AOTA.[13]

Whether the baccalaureate degree was adequate for entry to practice in occupational therapy has been questioned by many in the profession since the late 1950s. In 1999, ACOTE mandated that all professional entry–level occupational therapy programs must be offered at the post–baccalaureate level by January 1, 2007 to receive or maintain accreditation status.[11,13] Additionally, in August of 2004, ACOTE transitioned from using 1 set of standards for all OT programs to creating separate standards for each entry–level degree, master's and doctorate. Additionally, new separate accreditation standards were formally adopted in 2006: one for the master's programs and one for doctoral programs. These new standards became effective January 2008.[13]

Since 2007, there are 2 degree levels for entry into practice in occupational therapy: master's and doctorate. As of 2010, there are 146 accredited entry–level programs in the U.S., of which 142 grant a master's degree and 4 grant a doctorate degree.[14] Regardless of degree, to obtain the status of Occupational Therapist, Registered (OTR), students must graduate from an accredited program, successfully pass the National Board for Certification in Occupational Therapy (NBCOT) and fulfill any additional state or territory–specific requirements.[11]

AOTA established occupational therapy's Centennial Vision in 2003, which states: "We envision that occupational therapy is a powerful, widely recognized, science–driven, and evidence–based profession with a globally connected and diverse workforce meeting society's occupational needs."[15] After identifying relevant elements and barriers, 4 strategic initiatives materialized in the Centennial Vision for occupational therapy. These include building the capacity to fulfill the profession's potential and mission, demonstrating and articulating value to individuals, organizations and communities, building an inclusive community of members, linking education research and practice.[15,16]

Physician Assistant

The American Academy of Physician Assistants (AAPA) defines physician assistants as health professionals licensed to practice medicine with physician supervision. Physician assistants exercise autonomy in medical decision making and provide a broad range of diagnostic and therapeutic services.[17]

Dr. Eugene Stead of the Duke University Medical Center in North Carolina assembled the first class of physician assistants in 1955. It was comprised of Navy corpsmen who received considerable medical training during their military service. The curriculum was based in part on his knowledge of the fast–track training of doctors during World War II.[18] The number of physician assistant programs grew rapidly in the 1970s and were located in a variety of institutions, including medical schools, community colleges, teaching hospitals and vocational schools. Consequently, a wide range of credentials were awarded including certificates, associate degrees and a few baccalaureate degrees.[18,19]

The first accreditation standards for physician assistant programs, The Essentials of an Accredited Educational Program for the Assistant to the Primary Care Physician, were developed in 1971 by the AMA Subcommittee of the Council on Medical Education's Advisory Committee on Education for Allied Health Professions and Services. The subcommittee included representatives from the American Academy of Family Physicians (AAFP), American Academy of Pediatrics (AAP), American College of Physicians (ACP), American Society of Internal Medicine (ASIM), AMA and Association of American Medical Colleges (AAMC). The Essentials were approved by those organizations except for the AAMC, which declined to approve or endorse. In 1988, the Joint Review Committee for Educational Programs for the Assistant to Primary Care Physician was renamed the Accreditation Review Commission on Education for the Physician Assistant (ARC–PA). The ARC–PA began operation as a free–standing accrediting agency in 2001.[20]

The movement towards an entry–level master's degree started in the late 1980s, as several key institutions restructured their curricula to award a master's degree. Factors that influenced this transition included a well–educated applicant pool, rigor of the curriculum and advancements in other health professions toward a masters–level degree.[19]

All new physician assistant programs established after September 2006 must award a baccalaureate degree or higher. As of March 2011, there are 156 accredited entry–level physician assistant programs in the U.S., of which 4 grant certificates, 4 grant associate degrees, 19 grant baccalaureate degrees and 129 grant master's degrees.[20] All of the certificate and associate programs for physician assistant education have articulation agreements with other institutions for obtaining a baccalaureate and/or master's degree, and some require dual application for concurrent enrollment. Regardless of academic degree, to obtain a license to practice, students must graduate from an accredited physician assistant program, successfully complete of the NCCPA's Physician Assistant National Certifying Exam and fulfill any additional state or territory–specific requirements.

The physician assistant profession is currently advancing its entry to practice to the graduate level. The ARC–PA has raised the accreditation standard for programs by requiring all programs accredited prior to 2013 that do not currently offer a graduate degree to transition to conferring a graduate degree, which should be awarded by the sponsoring institution upon all physician assistant students who matriculate into the program after 2020.[21] Institutions planning to develop a program and apply for provisional accreditation that do not meet these eligibility requirements will not be considered by the ARC–PA.

The organization states in their accreditation standards, ARC–PA Standards, fourth edition, "The [physician assistant] profession has evolved over time to one requiring a high level of academic rigor. Institutions that sponsor [physician assistant] programs are expected to incorporate this higher level of academic rigor into their programs and award an appropriate master's degree."[21] Requiring an entry–level doctoral degree for physician assistants has been discussed but there are no official goals or professional position statements to date.[18,22]

Nursing

The American Nurses Association (ANA) defines nursing as the protection, promotion and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response and advocacy in the care of individuals, families, communities and populations.[23]

The education of nurses began as hospital–based training programs during the late 1800s. In an attempt to raise nursing school standards in 1917, the National League of Nursing Education published A Standard Curriculum for Schools of Nursing. Up until the 1950s, there were 2 routes to the registered nurse credential: a diploma from a hospital–based program or a baccalaureate from an institute of higher education. The creation of the associate degree registered nurse during the 1950s stemmed from the nursing shortage, growth of community and junior colleges and consumer and government interest.[24,25] The U.S. Surgeon General's Consultant Group on Nursing enacted the Comprehensive Nurse Training Act of 1964 which enhanced the quality of nursing education by consolidating the number of education and training programs and supplying funds for student loans, education grants and traineeships.[26] As a result, the Board of Directors of the ANA adopted a position paper with the recommendations that the minimum preparation for beginning professional nursing practice should be at the baccalaureate level, that there be a requirement making the baccalaureate degree the minimum standard for a registered nurse license, that a new license and title be created for associate degree nurses designating these practitioners as Registered Associate Nurses and that 2 types of technical nursing education programs: hospital–based diploma programs and practical nursing programs, be eliminated.[27]

Today, programs are accredited by the National League for Nursing Accrediting Commission, Inc. and vary in length from 2 to 4 years depending on program type. Additionally, the American Association of Colleges of Nursing developed the Commission on Collegiate Nursing Education in 1996, an accrediting body specifically for baccalaureate and graduate degree nursing programs.

Despite the entry–to–practice dilemma that has existed in the nursing profession for more than 40 years, there are still 3 entry points to the professional nursing credential: diploma, associate and baccalaureate. There are 935 accredited programs for entry–level nursing in the U.S., of which 59 grant diplomas, 617 grant associate degrees and 259 baccalaureate degrees.[28] Regardless of academic degree, a graduate must pass a state

licensure examination called the National Council Licensure Examination for Registered Nurses to obtain the registered nurse credential.

Although the nursing profession has not reached a common ground for the entry–level degree, it is responding to the changing needs of higher education by utilizing distance education programs, developing accelerated baccalaureate tracks for students who hold non–nursing degrees and implementing new graduate programs, such as the clinical nurse leader, to attract other health care professionals to the nursing profession. In May 2010, the Tri–Council for Nursing, which includes 4 independent organizations: the American Association of Colleges of Nursing, ANA, American Organization of Nurse Executives and National League for Nursing, issued a consensus statement calling for all registered nurses to advance their education in the interest of enhancing quality and safety across health care settings. The statement advocates for changes in nursing practice and education, challenges nurses to advance their education to the baccalaureate level and beyond and calls for state and federal funding for initiatives that facilitate nurses seeking academic progression.[29]

Respiratory Therapy

The American Association of Respiratory Care (AARC) defines respiratory therapists as health care professionals who specialize in the promotion of optimum cardiopulmonary function and health. Respiratory therapists employ scientific principles to identify, treat and prevent acute or chronic dysfunction of the cardiopulmonary system. Knowledge and understanding of the scientific principles underlying cardiopulmonary physiology and pathophysiology, as well as biomedical engineering and technology, enable respiratory therapists to provide patient care services effectively.[30]

On–the–job training and apprenticeships programs for inhalation therapists or oxygen technicians started in hospital–based programs. Formal education for the respiratory care profession began in the late 1940s, with national standards for schools in place by 1950. Educational programs in community colleges and technical schools flourished in the 1960s. Minimum program length was set at 18 months in 1962.[31,32]

In the 1980s, there was a high demand for respiratory therapists. This resulted in programs artificially shortening their curriculum to meet the demands of society. Many feel that the demands were met at the expense of the advancement of the profession. As respiratory care evolved from task–based, technical functions to providing more complex services, curriculum length increased as the knowledge base expanded. Programs began shifting to colleges and universities that could award academic credit and degrees. During the 1990s, the American Association for Respiratory Care supported research on the future scope of practice and education of respiratory therapists. These efforts contributed to the growing recognition of the need for an associate degree minimum academic preparation for entry–level therapists.

There are 2 pathways for entry into practice for respiratory therapy, the associate degree and the baccalaureate degree. As of 2010, there are 409 accredited entry–level respiratory therapy programs in the U.S., of which 53 programs award a baccalaureate degree and the other 356 award an associate degree.[33] The minimum length of the program must be 2 academic years of full–time instruction or its equivalent. Regardless of academic degree, the entry–level credential, Certified Respiratory Therapist (CRT), can be attained upon successful completion of a national examination. The Registered Respiratory Therapist (RRT) credential may be obtained by successful completion of 2 additional examinations. Both the CRT and the RRT are credentialed by the National Board for Respiratory Care.[34] On January 10, 2003, AARC issued a Landmark Statement on education and credentialing which stated: "There is a need to increase the number if respiratory therapists with advanced levels of training and education to meet the demands of providing services requiring complex cognitive abilities and patient management skills. Therefore the AARC strongly encourages the continuing development of baccalaureate and graduate education in respiratory care, to include: traditional BS degree programs, associate degree to baccalaureate degree articulation and bridge agreements, distance education for BS degree programs offered at the community college level, promotion of master of science in Respiratory Care degree programs for the development of leadership in the areas of management, education, research, and clinical specialization."[31]

Effective July 1, 2010, the Commission on Accreditation for Respiratory Care (CoARC) mandated that programs be at least 2 years in length and award a minimum of an associate degree. Students enrolled in a 100–level program must graduate by December 31, 2012, to be recognized as graduates of a CoARC–accredited program.[35]

The 2009 Coalition for Baccalaureate and Graduate Respiratory Therapy Education survey provided the profession an updated roster of programs

which award baccalaureate and master's degrees in respiratory care. This survey also revealed considerable interest in developing future programs – 22 programs intend to initiate a program at this level. AARC developed a task force to direct the future of the respiratory therapist profession into 2015 and beyond. One of the 10 recommendations was to request that CoARC change Standard 1.01 to require a baccalaureate or graduate degree for entry into the profession.[36] A statement on the CoARC website expresses the commission's current position: "CoARC will continue accrediting and serving associate degree programs. While the CoARC supports the development of academic advancement pathways for the associate degree graduate in gaining baccalaureate and graduate degrees, the members of the Commission continue to strongly support the associate degree as the minimum degree required for entry to the profession."[37]

Dental Hygiene

The American Dental Hygienists' Association (ADHA) defines dental hygienists as licensed health care professionals, who support the health and well being of the American public through oral health promotion, education, prevention and therapeutic services.[38]

The appearance of dental hygiene in the dental profession gained momentum in the late 1800s. Dentists began seeing the benefits of preventive care and implemented it in their own offices. Some dentists trained their own dental nurses without the benefit of formal coursework. However, Dr. Alfred C. Fones outlined a course of study for his dental assistant, Irene Newman, to train her in this new specialty. Within 3 years, he had trained and graduated 97 students. In 1915, the scope of practice of the dental hygienist was legally defined for the first time when Connecticut enacted an amendment to their dental practice law to regulate the practice of dental hygienists. The first dental hygiene training programs were 9 months to 1 year in length. The professional association, ADHA, was formed in 1923 and association leaders quickly noticed the need for standardization within the profession.[39]

The first dental hygiene accreditation standards were mutually developed in 1947 by 3 groups: the ADHA, the National Association of Dental Examiners and the American Dental Association's Council on Dental Education, which became the current Commission on Dental Accreditation (CODA) in 1975. CODA is the sole accrediting agency for dental education programs. Of the 30 CODA rep-

resentatives, 1 member is from the ADHA.[40]

According to CODA Standards for Dental Hygiene Programs, the curriculum must include at least 2 academic years of full–time instruction or its equivalent at the post–secondary college level. The scope and depth of the curriculum must reflect the objectives and philosophy of higher education. In a 2 year college setting, the graduates of the program must be awarded an associate degree. In a 4 year college or university, the graduates of the program must be awarded an associate degree, certificate or a baccalaureate degree.[41]

Entry to most dental hygiene programs requires approximately 3 semesters of prerequisite course work prior to the mandatory 2 year dental hygiene curriculum. In a recent ADHA survey, 79.9% of first year students had already completed at least 2 years of college.[42] Diploma, associate and baccalaureate are the 3 entry–level degrees awarded in dental hygiene. According to the 2009–2010 Survey of Allied Dental Education, there were a total of 309 accredited entry–level programs in the U.S., of which 8 awarded certificates, 253 awarded associate degrees and 38 awarded baccalaureate degrees.[42] As of August 7, 2011, the number of accredited programs has increased to 325.[43] Regardless of academic degree, to practice in the U.S., a candidate must graduate from an accredited dental hygiene program and successfully complete both a written National Board Dental Hygiene Examination and a clinical state or regional examination for individual state licensure.[44]

The results of a 1931 ADHA survey showed that dental hygienists thought that program length should be increased to 2 years and culminate in a baccalaureate degree.[39] In June of 2005, the ADHA published the report Dental Hygiene: Focus on Advancing the Profession, which outlines a path for the future of dental hygiene. The report recommended that the entry point to dental hygiene move from the associate's degree to the baccalaureate within 5 years.[38] Many barriers to enrolling in advanced dental hygiene education programs, beyond the associate's degree, have been cited in the literature.[45,46] Some of the barriers noted are the belief that the associate's degree is sufficient for clinical practice, lack of degree value/benefit, time and funding.[38,45–47]Apprehension about completing a thesis is cited as a barrier to pursuing graduate dental hygiene education.[46] Although the formal educational requirement of a 2 year academic program has remained unchanged, there have been some advancements in the practice and regulation of the profession.[38,39]

Dental hygiene licensure is regulated by individual state boards, yet licensing exams have evolved from independent state exams to 5 regional testing agencies, with the exception of Delaware which does not accept a regional exam.[48] Supervision of dental hygienists vary by state.[49] Direct supervision requires that a dentist must be present in the facility when a dental hygienist performs procedures. General supervision requires that a dentist has authorized a dental hygienist to perform procedures but need not be present during the performance of those procedures. Direct access does not require specific authorization from a dentist and a dental hygienist can provide services as determined appropriate. General supervision is allowed in 47 states and direct access is allowed in 32 states.[50]

Dental hygienists were first allowed to administer local anesthesia in the state of Washington in 1971, and now 44 states allow this expanded function.[51] Administration of nitrous oxide sedation is allowed in 29 states.[52] Restorative duties allowed by dental hygienists vary by state, yet are mostly prohibited.[53] According to a June 2010 ADHA report, there are 15 states that contain statutory or regulatory language allowing the state Medicaid department to directly reimburse dental hygienists for services rendered.[54] In all remaining states, dental hygienists cannot be directly reimbursed for their services.

Dental hygiene does not meet the strict interpretation of a profession since it lacks autonomy and self–regulation.[1] There are 17 states that have dental hygiene committees with some authority regarding practice, but none have final regulatory powers.[55] The profession is regulated by a State Board of Dentistry or Department of Health and may contain 1 or more dental hygiene members.[55] Pending state and federal legislation impacting dental hygiene in the areas of self–regulation, direct access and workforce is tracked on the ADHA's website.[56]

The ADHA Strategic Plan Year 2010 to 2012 outlines advocacy goals for the profession, which includes objectives to increase the autonomy of dental hygiene and to increase the public's direct access to dental hygienists. Strategies for increasing autonomy include exploring the development of a dental hygiene accrediting agency and supporting the advanced dental hygiene practitioner (ADHP) workforce model.[47] The action plan for developing an accrediting agency includes securing funding for an accreditation consultant to conduct a comprehensive feasibility study. A recent study on the status of the ADHP reported several states

are planning ADHP graduate programs while dental therapists and advanced dental therapists entered the Minnesota workforce in 2011.[57,58]

In February 2010, CODA received requests to accredit the educational programs in dental therapy and advanced dental therapy from the Minnesota Board of Dentistry, the Minnesota Dental Association, the University of Minnesota and Metropolitan State University. In August 2010, CODA determined that it would not proceed with the development of a process to accredit dental therapist education programs.[59] Finally, in August 2011, CODA voted to develop accreditation standards for these advanced programs. The American Dental Association immediately responded in opposition, stating that they are "on record as firmly opposing anyone other than a dentist diagnosing oral disease or performing surgical/irreversible procedures."[60]

Discussion

Based on what has been learned from other health care professions, the authors make the following recommendations for dental hygiene:

1. Create an Accreditation Council for Dental Hygiene Education, under the auspices of the ADHA to provide self regulation of the profession: This was a critical step for the advancement of all other professions discussed in this manuscript and is also a component of the ADHA Strategic Plan 2010 to 2012.[47]

2. Mandate articulation agreements for all existing certificate/associate degree programs to provide baccalaureate degree completion. An entry–level bachelor's degree will move dental hygiene closer to the norm of other health professions. Similar to respiratory therapy in the 1980s, dental hygiene has experienced curriculum creep, squeezing too much information into dental hygiene curricula at the expense of the advancement of the profession.[31] Accordingly, the rigor of the dental hygiene curriculum should be made equivalent to the degree granted. This has been done in other health professions but not in dental hygiene. Physical therapy and occupation therapy advanced their entry to practice to a graduate level in 2002 and 2007, respectively.

3. Mandate articulation agreement requirements for the initial accreditation of all developing programs: Professions that have moved from a 2 year to 4 year program experienced a natural growth in bachelor programs, while certificate and associate programs reduced. Physician assistant programs established after 2006 must

offer a baccalaureate degree. The few that still award certificate or associate degrees are mandated to offer concurrent enrollment with institutions granting higher degrees.

Conclusion

All of the professions reviewed in this manuscript evolved as a means to increase the population's access to care and entry level education advanced due to the academic rigor needed to provide safe care to patients, such as the medically compromised. Fundamental change cannot happen instantaneously. It may take years or even decades. Yet, the similarity among these professions is that they all have mapped out their vision to educate their graduates and practicing clinicians. In 1931, dental hygienists wanted to raise the standards of the profession. Eighty years later, are we any closer to that vision? Dental hygiene must continue on the path to advance our profession and glean lessons from other health professions.

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Interrelationship Between Pyogenic Granuloma and Peripheral Ossifying Fibroma: A Case Report

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Introduction

A smile is an assembly of various components, such as marginal gingiva, interdental papilla and teeth. Often the pink aesthetics (gingiva) is subjected to various insults by local factors, such as plaque and calculus, which can occasionally lead to overgrowths of granulomas or fibromas. Oral pyogenic granuloma (PG) is the most common gingival tumor. This soft, lobulated elevated growth, which may ulcerate spontaneously and may bleed on minimal trauma, is considered to be a reactive tumor like lesion arising in response to poor oral hygiene leading to a chronic low grade irritation.[1] The term "Pyogenic Granuloma" is a misnomer as it is now believed to be unrelated to infection, does not contain pus and is not, strictly speaking, a granuloma.[1] It is stated that PG usually affects females between 11 to 40 years of age.[2] Another focal overgrowth occurring in the gingiva is Peripheral Ossifying Fibroma (POF), which has a predilection to occur in females and is more common in young adults.[3] The suggested etiology appears to be similar for both PG and POF, such as low grade irritation due to plaque and calculus. Histologically it is characterized by a high degree of cellularity usually exhibiting bone formation. It is reported that occasionally cementum like material may be found.[3]

Though many case reports on PG and POF have been published,[4–8] there are fewer published reports describing the interrelationship between these 2 reactive overgrowths. The purpose of this article is to present a case of PG followed by a recurrence of the lesion after a year as a POF.

Abstract

Purpose: Pyogenic Granuloma (PG) is an inflammatory hyperplasia which is non–neoplastic in nature. Because of the high incidence of oral PG, critical need exists for its proper diagnosis and treatment. Peripheral Ossifying Fibroma (POF) is a focal reactive overgrowth occurring in young adults. Though clinically similar to PG, it is important to differentiate the lesions based on the histopathological findings that facilitate the management of the lesion, which is diverse in nature when compared to PG. Proper treatment of such overgrowths and appropriate oral hygiene instructions shall ensure no recurrence of the lesion.

There are very few case reports published depicting the recurrence of 1 lesion into another reactive overgrowth, and fewer case reports exists describing the interrelationship between these 2 lesions. Hence this case report depicts the interrelation between these 2 reactive fibrous overgrowths having different histomorphologic representation. Also, the importance of histopathologic diagnosis and a proper treatment plan is emphasized to prevent unnecessary distress to the patient regarding the severity of such lesions.

An irregular gingival overgrowth occurring in the mandibular anterior region diagnosed histopathologically as PG in a 35 year old female is described. The lesion was excised. Furthermore, it recurred after a year in the same region and the histopathologic diagnosis of the lesion confirmed it as POF. The overgrowth was excised and thoroughly curetted. The case was followed up to 1 year without any signs of recurrence.

Keywords: Epulis, Gingival overgrowth, Peripheral Ossifying Fibroma, Pyogenic granuloma

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

Case Report

A 35 year old female patient reported to the Department of Periodontics with a complaint of an isolated swelling of the gingiva in relation to her mandibular anterior teeth. She found it aesthetically unacceptable. She noticed the soft tissue growth in the past 2 to 3 months prior to her visit. This growth was initially small and grew gradually in size.

Clinical Examination

On examination, there was an irregular shaped, reddish pink overgrowth of about 1 cm in diameter which was not tender and seemed to be pedunculated, arising from the interdental papilla between the mandibular central incisors with considerable amount of local factors (Figure 1). A provisional diagnosis of Epulis (Pyogenic granuloma) was made and an initial therapy of scaling was performed.

Treatment

The overgrowth was excised and a periodontal dressing was placed. The patient was recalled after a week for removal of the dressing and evaluation. The excised tissue was dispatched for histopathological examination.

Histopathologic examination of the excised tissue

Microscopic examination revealed moderately dense fibrocellular connective tissue stroma with rich vascularity, with numerous single endothelial lined dilated and engorged vessels. A moderately dense chronic inflammatory reaction was also associated with the tissue which was covered with parakeratinized stratified squamous epithelium of variable thickness (Figure 2). Histopathological diagnosis was reported as PG. She was recalled once a month for 3 months and there was no sign of recurrence of the gingival overgrowth.

After a year, the patient reported back with a similar complaint of a growth in the same region. She expressed that the growth began to reappear around 8 months after the first surgical excision and was gradually increasing in size, leading to spacing between her mandibular anterior teeth. In addition, she complained of difficulty in mastication because of the growing lesion. She was apprehensive regarding the recurrent overgrowth fearing it to be a malignant lesion.

Clinical examination of the recurrent overgrowth

On examination, an ovoid pale pink firm gingival overgrowth measuring around 1 cm by 1 cm was present at the same site of previous lesion. The enlarged tissue seemed to be pedunculated with a stalk attaching the buccal and lingual part of the interdental papilla (Figure 3).

Radiographic examination

An intra oral periapical radiograph of the region

Figure 1: Gingival overgrowth present between mandibular central incisors.

Figure 2: Microscopic picture showing numerous engorged capillaries and moderately dense chronic inflammatory reaction in a fibrocellular stroma. Original magnification x 100
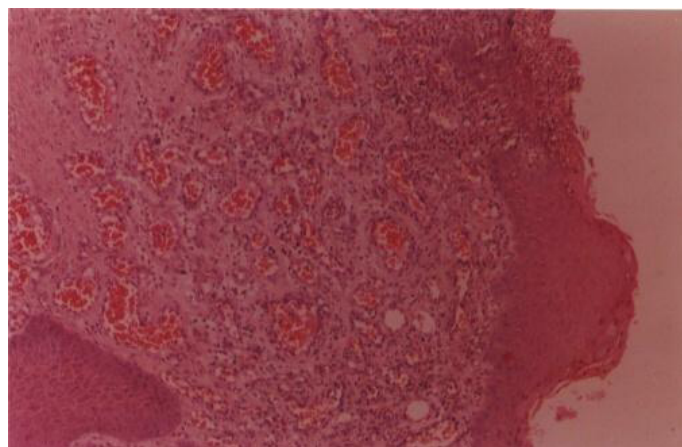
Figure 3: Ovoid pale pink firm gingival overgrowth present between mandibular incisors

at the time of recurrence revealed widening of the periodontal ligament space of the mandibular central incisors and mesial of right mandibular lateral incisors. Also, a mild interdental bone loss was noticed between mandibular incisors (Figure 4). A pro-

visional diagnosis of recurrence of epulis (pyogenic granuloma) was made and a further treatment plan was formulated. The differential diagnosis consisted of irritational fibroma and peripheral giant cell granuloma.

Treatment

Since there were no true pockets present with the same region, excision of the lesion by means of gingivectomy was performed. The lesion was excised and the area thoroughly curetted. Prophylaxis was performed in relation to the involved adjacent teeth. Periodontal dressing was placed over the region and was removed after a week.

Histopathologic examination of the excised tissue

Microscopic examination of the excised tissue revealed a dense cellular connective tissue stroma with many osteoid deposits and few small basophilic calicific deposits covered by parakeratinized stratified squamous epithelium. The connective tissue showed adequate vascularity and a moderate dense chronic inflammatory reaction (Figures 5, 6). The histopathological diagnosis was reported as POF.

Follow–up

Explanations were given to the patient regarding the nature of the lesion and the treatment rendered to her. She was also motivated to come for a regular follow up and was recalled once in 3 months. She was evaluated for a period of 1 year without any sign of recurrence.

Discussion

PG is regarded by some investigators as a benign neoplasm, though it is usually considered to be a reactive tumor–like lesion arising in response to various stimuli, such as a chronic low grade local irritation, traumatic injury, hormonal factors or even due to certain kinds of drugs.[9] PG of the gingiva develops in up to 5% of pregnancies.[9] The rapid growth of this lesion could be attributed to certain growth factors like basic fibroblast growth factor, connective tissue growth factor, vascular endothelial growth factors and by additional factors such as nitric oxide synthetas.[9] Though surgical excision with blade is the common treatment modality, new treatment protocols include laser excision (Nd:YAG laser, flash lamp pulsed dye laser), cryosurgery and electrodessication.[9] Alternative modalities include intralesional injection of ethanol or corticosteroid and sodium tetradecyl sulphate sclerotherapy.[9]

Figure 4: Radiograph reveals crestal bone resorption between mandibular central incisors
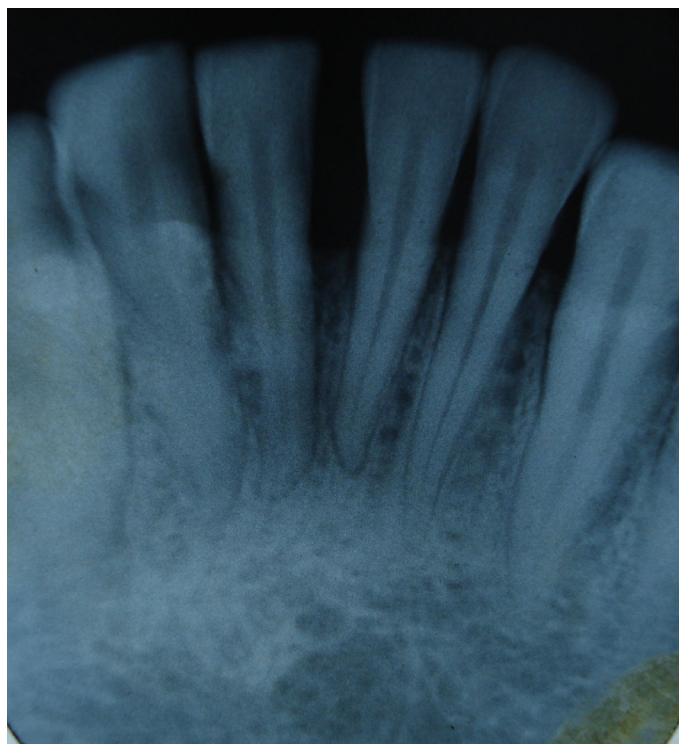
Although the excision should be conservative, it should extend down to the periosteum and the adjacent teeth should be thoroughly scaled to remove the source of continuing irritation.[1] It has been stated that recurrence occurs in up to 16% of the lesions,[9] the causes for which could be attributed to incomplete excision, failure to remove etiologic factors or re–injury of the area.[10] Though a thorough excision of the lesion was performed in the present case, the overgrowth recurred in the same area after 1 year.

POFs account for 9.6% of gingival lesions.[11] The numerous terminologies used for these gingival lesions, such as peripheral odontogenic fibroma, peripheral cementifying fibroma[12] or calcifying fibroid epulis,[3] indicates that there is a lot of controversy regarding the classification. Fibro osseous lesions of the jaw continue to present problems in diagnosis and classification to clinicians and pathologists despite the advances in our understanding of this entity. Waldron et al classified these lesions into 3 main categories: fibrous –dysplasia, reactive lesions (periapical cemento–osseous dysplasia and florid cemento–osseous dysplasia) and fibro–osseous neoplasm.[13] Cemento ossifying fibroma is included in the third category of non–odontogenic tumors since the 1992 World Health Organization classification.[13] The mineralized product seen in ossifying fibromas probably originates from periosteal cells or from the periodontal ligament. The reasons for

Figures 5 and 6: Microscopic pictures showing few irregular osteoid deposits with few small basophilic calcifications surrounded by dense cellular stroma with adequate vascularity and moderately dense chronic inflammatory reaction
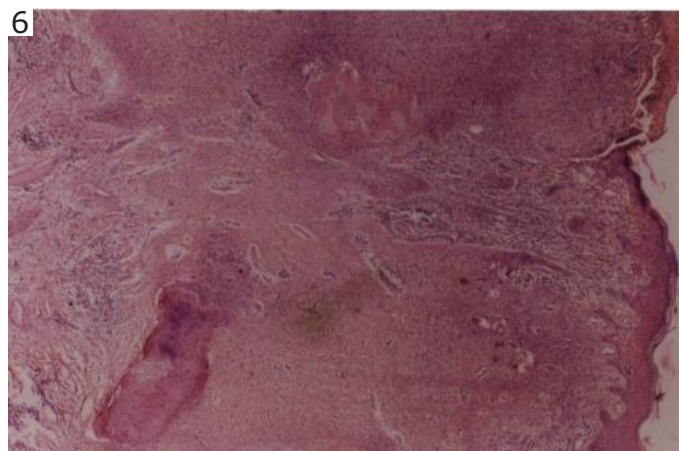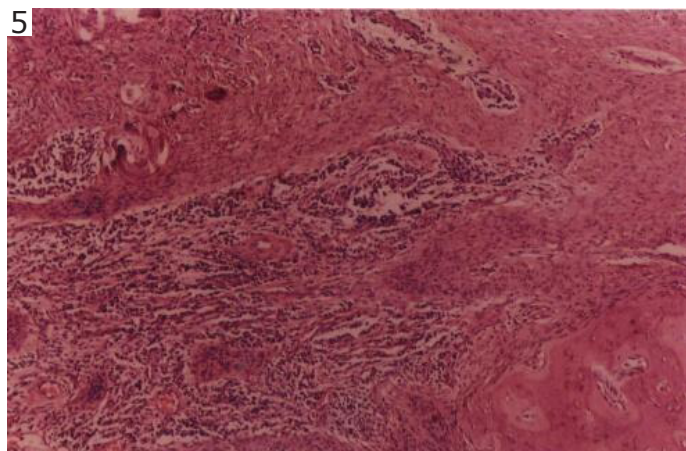
Original magnification x100 (Figure 5) and x40 (Figure 6)

Figure 7: Postoperative facial view after one year without any sign of recurrence of gingival overgrowth.

considering periodontal ligament origin is the exclusive occurrence of these fibromas in the gingiva (interdental papilla), the proximity of gingiva to the periodontal ligament and the presence of oxytalan fibers within the mineralized matrix of some lesions and the fibrocellular response, which is similar to other reactive gingival lesions of periodontal ligament origin.[14]

POF has been stated to occur frequently in the maxillary anterior region and more in the adolescent age group.[15] In the present report, the lesion was observed in a 35 year old patient in the mandibular anterior area, which contradicts the age of incidence and the site of the lesion. There are very few reported cases of isolated POF in the mandibular anterior area. Although the size of the lesion usually is described around 1.5 cm,[16] a recent report presented a lesion of around 6 cm in the mandibular premolar region.[17] The overgrowth presented in our case was well within the normal range. There is a variation in the radiographic features of these lesions. Radiopaque foci of calcifications have been reported to be scattered in the central area of the lesion but not all lesions demonstrate radiographic calcifications.[18] Underlying bone involvement is usually not associated, however, in rare instances superficial erosion of bone is noted.[18] This was seen in the present case where resorption of crestal bone was seen between the mandibular central incisors. POF can sometimes lead to tooth separation.[19] This, too, was noted in the present case, leading to separation of mandibular central incisors.

Ossifying fibromas elaborate bone, cementum and spheroidal calcifications, which has given rise to various terms. The term cemento ossifying has been referred to as outdated and scientifically in-

accurate because the clinical presentation and the histopathology of cemento ossifying fibroma are the same in areas where there is no cementum, such as the skull, femur and tibia. Also, there is no histologic or biochemical difference between cementum and bone.[12] Cemento ossifying fibroma is the term given mainly due to the presence of dysmorphic round basophilic bone particles within ossifying fibroma, which have arbitrarily been called cementicles.[12] The preferred treatment is local surgical excision, which should extend up to the periodontal ligament and periosteum at the base of the lesion. This was performed in the present case. The recurrence rate for POF is documented as 8.9 to 20%.[20] The recovery was uneventful in the present case and the patient was followed for 1 year on a regular recall basis wherein she remained tumor free.

Investigators have attempted to establish a relationship between PG and POF, stating that PG and POF may represent progressive stages of the same

pathology.[17] It has been suggested that long standing PG may undergo organization and healing, which is evident histologically with features of decreased vascularity, decreased inflammation and focal ossification.[17] This long duration and maturation may lead to the development of POF. However, it has also been suggested the POF is a separate clinical entity rather than a transitional form of PG.[21] In the present case report, the clinical and histopathological features of the initial and recurrent lesions avowed the theory that PG and POF may represent progressive stages of the same pathology. Whatever the reason for the occurrence of a second lesion, the authors continue to believe that PG and POF belong to the same spectrum of focal reactive overgrowths.

Conclusion

When a gingival overgrowth is found, it is important to formulate an appropriate diagnosis of the condition, which would help in management of the patient. Histopathological findings have an important role and are definitive in establishing a diagnosis. The treatment of these focal reactive overgrowths is complete elimination of the lesion and etiologic factors. Regular follow up is also very essential to avoid recurrence of the lesion.

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Environmental Tobacco Smoke and Periodontitis in U.S. Non–Smokers

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Introduction

The American Academy of Periodontology (AAP) estimates prevalence of moderate to severe generalized periodontitis to be 30% or higher in the U.S. adult population, depending on the classification.[1] Periodontal disease impacts a large number of Americans and plays a role in other more serious and costly health problems. Periodontitis is a leading cause of tooth loss, tooth mobility and dental abscess, and is also positively associated with cardiovascular disease,[2] obesity,[3] Alzheimer's disease[4] and diabetes mellitus.[5–12] The disease is characterized by chronic inflammation, loss of attachment and bone loss. The condition is primarily caused by bacteria in dental plaque acting alone or in conjunction with systemic and genetic factors.[13] Other factors associated with the disease include psychological stress,[14] certain medications,[15,16] genetics[16] and tobacco use.[12,17,18] In fact, tobacco use is causally associated with periodontitis[12,18–21] in a dose dependent relationship,[22] and studies estimate the smoking attributable risk to be 20%.[1] Cigarette smoking, along with vasoconstriction, impacts individual cells involved with the perpetuation of periodontal disease, such as those involved in inflammation, immunity, cell differentiation and healing.[23] Within the estimated 3.6 to 5% of Americans with periodontal disease,[24,25] current smokers exhibit higher rates of disease.[26] Smoking alters microbial and host response factors in periodontitis, and has been implicated in bone loss, such as osteoporosis.[27] In respect to microbes, preliminary findings by Teughels et al indicate that individual periopathogens' (A. Actinomycetemcomitans and P. Gingivalis) colonization of tissues could be impacted by nicotine, found in smoke, in a species–specific manner.[28] Environmental tobacco smoke (ETS), like active smoking, impacts the immune response, namely polymorphonuclear leukocyte (PMN) function such as phagocytosis, chemot-

Abstract

Purpose: The association of second hand smoke or environmental tobacco smoke (ETS) and periodontitis in non–smokers has not been confirmed using a biomarker of ETS exposure. To estimate periodontitis prevalence in non–smokers with detectable serum cotinine, and to investigate racial/ethnic and socioeconomic variation in ETS exposure in a representative sample of the U.S. adult population. Determining periodontitis risk indicators occurring with ETS appears to be a salient purpose as this study is the first of its kind to provide a link (a salivary biomarker) between second hand smoke and risk for periodontitis.

Methods: Data were collected from the 1999 to 2004 National Health and Nutrition Examination Survey (NHANES). Subjects were 3,137 adults who had smoked fewer than 100 cigarettes and had not used other forms of tobacco. ETS exposure was classified as negligible (cotinine concentrations below sex and race/ethnicity cut–points for smokers), moderate (cotinine 0.5–<1.5 µg/mL) or high (cotinine≥1.5 ng/mL). Periodontitis was classified according to the Centers for Disease Control and Prevention (CDC) and the American Academy of Periodontology (AAP) case definition for moderate–severe disease. Survey estimation procedures were used to estimate prevalence and odds ratios (OR) were from multivariable logistic regression models.

Results: ETS exposure was observed in 40.5% of subjects and 2.6% had periodontitis. ETS exposure was inversely associated with educational attainment and family income and was higher in non–Hispanic blacks than whites. After adjusting for age, sex and year of survey, adults with high ETS exposure (cotinine≥1.5 ng/mL) had more than twice the odds of periodontitis as people with negligible exposure (OR=2.3, 95% confidence interval=1.3, 4.1).

Conclusion: High ETS exposure was a risk indicator for periodontitis in lifetime non–smokers.

Keywords: Cotinine, Periodontal disease, Serum–plasma, Tobacco

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Investigate how environmental factors (culture, socioeconomic status– SES, education) influence oral health behaviors.

axis and oxidative burst.[29] As reported by Numabe et al, phagocytic activities of PMN intensify after smoking and exposure to ETS.[29] Additionally, the results suggested that certain substances in smoke over–stimulate the host response in the oral cavity,29 making the exposed more likely to experience attachment and tooth loss.[30]

Risk for periodontitis increases with the number of cigarettes smoked, or consumption, with notable differences observed in as few as 10 cigarettes per day.[22,26,31,32] Periodontitis is 6 to 7 times as prevalent in the estimated 46 million adults in the U.S. who currently smoke.[33,34] Smoking also makes the disease more virulent and difficult to treat.[21,35,36]

Non–smokers exposed to ETS absorb approximately one–third the level of nicotine per cigarette absorbed by active smokers.[37-40] Physiological metabolism of nicotine after exposure yields cotinine (nicotine's metabolite) in saliva, urine and serum.[37] The concentration of cotinine in fluids allows determination of active smoking or environmental exposure, and provides a recent measurement of exposure, as well as an objective biomarker of exposure.[40]

There is evidence of a relationship between periodontitis in non–smokers and exposure to environmental tobacco smoke.[41,42] Arbes et al observed that non–smokers with self–reported ETS exposure had 1.6 times the odds for periodontal disease compared to those not exposed.[41,43,44] The increased risk for periodontitis occurs with the exposure to nicotine which over–stimulates the host response in the oral cavity, complicating the already inflammatory nature of periodontal diseases.[27,41] In fact, the inflammatory response in salivary inflammatory markers is notable among those exposed to secondhand smoke as ETS is associated with an elevated concentration of inflammatory makers interleukin –1β, albumin and aspartate aminotransferase, in those exposed to passive smoke.[45,46] To date, measurements of ETS in the periodontal literature are limited to self–report and no objective biomarker of exposure has been examined.

ETS exposure is unequally distributed between racial and ethnic groups. For physiological and behavioral reasons, non–Hispanic Blacks show higher concentrations of cotinine, with less exposure to cigarette smoke, than do non–Hispanic whites. Total and non–renal clearance of circulating cotinine is significantly lower in non–Hispanic blacks.[47] Furthermore, nicotine intake is 30% higher in African Americans, with a somewhat longer half–life for circulating cotinine.[47] The different absorption and manifestation of serum cotinine concentration in different races is supported by the prevalence of periodontitis cases. According to Albandar et al, African Americans and Mexican Americans display poorer periodontal health than whites with comparable income and educational attainment.[48] Signorello et al reported that "differences in cotinine levels among smokers suggest racial variation in exposure to/or metabolism of tobacco smoke constituents."[49]

Smoking and ETS exposure are known hazards to health, including the oral cavity, and tooth attachment apparatus.[12] Together with racial and socioeconomic status, the differing levels of ETS exposure and different rates of metabolism for serum cotinine provide a means and motivation to assess periodontal disease risk among the non–smoking population.[41] The aim of this study was to determine the prevalence of periodontitis in non–smokers with detectable serum cotinine, and to investigate the variation in ETS exposure among non–smokers classified according to racial and socio–economic characteristics.

Methods and Materials

Study and Sampling Designs

This cross–sectional study is nested within a larger study designed to examine the relationship of a state's cigarette excise tax on cigarette sales and levels of ETS. Data were obtained from the National Health and Nutrition Examination Survey (NHANES) release dates 1999 to 2000, 2001 to 2002 and 2003 to 2004. The NHANES is an ongoing representative survey of the health and nutrition status of the civilian, non–institutionalized U.S. population, conducted by the National Center for Health Statistics (NCHS).[50]

The NHANES uses a complex cross–sectional survey design to sample participants 2 months of age and older.[41] Because NHANES typically samples 15 primary sampling units per survey, the current study combined 3 survey releases to maximize the number of sampled states.

Data Collection

Data collection consisted of a household interview, blood draw and a medical examination including a dental examination, conducted in the Mobile Examination Center. The household interview included questions pertaining to socioeconomic characteristics, medical/dental history and health behaviors, such as smoking. During the physical examination, blood was collected by venipuncture to allow for serum cotinine measurement in participants over 3 years of age.[51] Signed informed

consent was obtained for all participants, in person or by proxy.

Participants

In the combined 1999 to 2004 NHANES data, 9,932 adults aged 20 years or older received a periodontal assessment. Those who reported having smoked at least 100 cigarettes in their lifetime (n=4,553) were precluded from analysis. Also precluded were 13 adults with undisclosed smoking status, along with individuals with a history of tobacco use through pipe, cigar, snuff or chewing tobacco (n=456). Examination of serum cotinine identified participants whose sex or race/ethnicity–specific concentrations exceeded thresholds for non–smokers (n=437), and these were likewise ineligible. Finally, adults having lived in the U.S. fewer than 10 years were precluded (n=1,336) since ETS exposure in these individuals could not be related to the state–level excise as this study is nested within a greater investigation of tobacco excise tax and its relationship to periodontitis. Hence this analysis was limited to 3,137 U.S. lifetime non–smokers.

Dependent Variable

An assessment of periodontal tissues was conducted by a licensed dentist during the NHANES oral examination. Examination measured bleeding on probing and periodontal pocket depth for 2 randomly assigned quadrants: 1 upper and 1 lower. Probing was done using a National Institute of Dental Research probe.

The assessment included permanent fully erupted teeth, excluding root tips, partially erupted teeth and third molars. Measurements used were taken from the mesial and mid–buccal aspects of the teeth from distal to mesial, beginning with the distal–most tooth, moving toward the midline. Over the 6 year survey period, periodontal measurement techniques differed. For release dates 1999 to 2000, periodontal measurements were taken at 2 sites on each assessed tooth: midbuccal and mesiobuccal. For release dates 2001 to 2002 and 2003 to 2004, measurements were collected from the midbuccal, mesiobuccal and distobuccal sites of teeth. For consistency during analysis, the mesiobuccal numbers were analyzed for the entire survey period, as interproximal sites pertain directly to the case definition used.

Periodontal cases were defined using a case classification developed by the AAP and the CDC.[24] The AAP defines moderate/severe periodontal disease as "two or more interproximal sites with clinical attachment level ≥4 mm, not on the same tooth, or two or more interproximal sites with probing depth ≥5 mm, not on the same tooth."[24]

Key Exposure Variable

Questions about smoking history and use of tobacco products were presented in the household interview. Environmental tobacco smoke exposure was measured using serum cotinine measurements collected during the medical examination. Exposure was defined as serum cotinine measurements ≥0.05 ng/mL, as this is the NHANES laboratory–limit for detection. The use of the biomarker cotinine was indicated due to its ability to reflect nicotine exposure over days and its specificity to nicotine,[52] evaluating only recent cigarette smoke exposure as opposed to all environmental inhaled substances.[53]

Independent Variables

Along with tobacco smoke exposure, the characteristics age, sex, educational attainment, annual family income and ethnicity were considered independent variables. These characteristics were identified during the household interview questionnaire.

Results

In this non–smoking subset of the general U.S. population, males and all individuals with low levels of education and family income were under–represented. According to serum cotinine concentrations, 40.5% of participants were exposed to ETS (Table I). Greater proportions of males than females were exposed, and adults 20 to 49 years of age were more likely to be exposed than were their older counterparts (p<0.001). Most pronounced differences in ETS exposure were found between racial groups. Two–thirds of African Americans were exposed compared with approximately one–third of Non–Hispanic whites (p<0.001). Even within this advantaged subset of the U.S. population, inverse socioeconomic gradients were observed in levels of ETS exposure (Table I).

The CDC/AAP case classification for moderate or severe periodontitis was met by 2.6% of participants (n=82, Table II). Of note, serum cotinine concentration was not significantly associated with periodontitis in unadjusted analysis. In addition, the associations of periodontitis with sex and race/ethnicity were statistically non–significant, while age and socioeconomic status were strongly associated with the disease. Odds of periodontitis were elevated 9–fold in adults with incomplete high school

Table I: Selected characteristics of the dentate non–smoking population aged 20 years or older, resident in the U.S. for ≥10 years, and the percentage exposed to environment tobacco smoke (n=3,137), NHANES 1999 to 2004

Characteristic	Unweighted n and weighted %	Exposure to ETS (%)[a]	95% CI	P–value
All	3,137 (100.0)	40.5	35.9, 45.2	
Sex				
Male	1,090 (36.9)	46.4	40.3, 52.6	<0.001
Female	2,047 (63.1)	37.0	32.7, 41.6	
Age group (years)				
20–49 years	2,003 (69.7)	43.9	38.9, 48.9	<0.001
50–85 years	1,134 (30.3)	32.6	27.7, 38.0	
Race/ethnicity				
Non–Hispanic White	1,858 (79.2)	36.2	31.1, 41.7	<0.001
Non–Hispanic Black	718 (12.4)	65.7	60.0, 71.1	
Hispanic	522 (6.9)	41.1	33.1, 49.7	
Other	39 (1.5)	51.3	31.4, 70.7	
Educational attainment				
Less than high school	513 (9.8)	58.4	51.0, 65.5	<0.001
High school graduate or equivalent	725 (22.7)	50.7	44.6, 56.7	
Some college or more education	1,898 (67.5)	34.4	29.4, 39.8	
Missing	1			
Annual family income				
<$25,000	930 (24.5)	54.2	47.5, 60.7	<0.001
$25,000–<$75,000	1,352 (44.4)	40.7	34.8, 46.8	
≥$75,000	756 (31.2)	29.1	23.7, 35.2	
Missing	99			

[a]Environmental tobacco smoke exposure was determined by sex– and race–specific thresholds of serum cotinine above the laboratory detection limit for 1999–2000 NHANES of 0.05ng/mL
b All estimates are weighted data, except the number of study participants, which is reported unweighted

education relative to those with at least some college education (OR=9.1, 95% CI: 5.2, 15.9). In the multivariable model (Table III) that adjusted for potential confounding of age and other factors, odds of periodontitis were 89% higher in adults with cotinine concentration ≥1.5ng/mL compared to those with negligible concentrations. The predicted probability of meeting the periodontitis case classification increased monotonically with increasing levels of serum cotinine concentration (Figure 1). For these results, binary logistic regression was computed using STATA software.

Discussion

This study sought to evaluate the relationship between environmental tobacco smoke and periodontitis in non–smokers using an objective biomarker. The primary finding was that periodontitis in non–smokers is negatively impacted by exposure to environmental tobacco smoke. This stands in agreement with similar previous studies such as Arbes et al who found a relationship between self–reported smoke exposure and periodontitis in non–smokers.[54] Other investigators have reported an increase in salivary markers related to periodontitis with exposure isolated through salivary cotinine.[45,46] NHANES data provided a representative sample of the American population, as well as a large sample size for analysis. Moreover, it allowed for analysis of tobacco use in addition to cigarettes alone. Specifically, it allowed for the study of participants controlled for cigar, pipe, snuff and chew tobacco use. Both the medical history questionnaire in the NHANES protocol and the serum concentration tests for serum cotinine added to reporting accuracy.

This study evaluated data from 1999 to 2004. Since that time regulations controlling exposure of

Table II: Mean (95% CI) serum cotinine level (ng/mL), prevalence of periodontitis (95% CI) and odds ratios for periodontitis (95% CI) according to socio-demographic characteristics of study participants (n=3,137), NHANES 1999 to 2004

Characteristic	Serum cotinine (ng/mL) mean (95% CI)	P–value	Periodontitis[a] prevalence (95% C.I.)	P–value	OR periodontitis (95% CI)
All	0.20 (0.18, 0.23)	–	2.61 (2.08, 3.26)	–	–
Sex					
Male	0.25 (0.21, 0.30)	<0.001	2.16 (1.46, 3.17)	0.302	1.34 (0.76, 2.36)
Female	0.17 (0.15, 0.20)		2.87 (2.09, 3.92)		Ref
Age group					
20–49 years	0.23 (0.20, 0.27)	<0.001	0.49 (0.32, 0.75)	<0.001	Ref
50–85 years	0.13 (0.10, 0.16)		7.46 (5.98, 9.28)		16.27 (10.49, 25.23)
Race/ethnicity					
Non–Hispanic White	0.16 (0.14, 0.19)	<0.001	2.33 (1.78, 3.04)	0.146	Ref
Non–Hispanic Black	0.50 (0.40, 0.59)		4.07 (2.84, 5.80)		1.78 (1.10, 2.88)
Hispanic	0.11 (0.08, 0.13)		2.70 (1.56, 4.63)		1.16 (0.64, 2.12)
Other	0.18 (0.06, 0.30)		4.79 (0.90, 21.77)		2.11 (0.42, 10.65)
Educational attainment[b]					
<High school	0.44 (0.33, 0.54)	<0.001	9.48 (6.96, 12.80)	<0.001	9.07 (5.16, 15.94)
High school or equivalent	0.26 (0.20, 0.32)		4.00 (2.60, 6.09)		3.60 (1.95, 6.65)
≥Some college	0.15 (0.12, 0.18)		1.14 (0.75, 1.72)		Ref
Annual family income[b]					
<$25,000	0.36 (0.28, 0.43)	<0.001	5.24 (3.77, 7.25)	<0.001	6.27 (2.45, 16.04)
$25,000–<$75,000	0.19 (0.15, 0.22)		2.32 (1.61, 3.33)		2.69 (1.07, 6.72)
≥$75,000	0.10 (0.07, 0.13)		0.88 (0.38, 2.00)		Ref
Serum cotinine concentration[c]					
<0.05 ng/mL	0.02 (0.02, 0.03)	<0.001	2.33 (1.66, 3.27)	0.509	Ref
0.05–<0.15 ng/mL	0.09 (0.08, 0.09)		3.06 (1.94, 4.80)		1.32 (0.73, 2.40)
≥1.5 ng/mL	0.82 (0.75, 0.90)		2.97 (1.96, 4.48)		1.28 (0.74, 2.22)

[a]CDC/AAP case classification for moderate or severe periodontitis defined as ≥2 interproximal sites with clinical attachment level ≥4 mm, not on the same tooth, or ≥2interproximal sites with probing depth ≥5 mm, not on the same tooth
[b]Fewer than 3,137 subjects were analyzed because of missing data
[c]The laboratory detection limit fort 1999–2000 NHANES (0.05) was applied for all years (1999–2004)

ETS to non–smokers have changed. For example, in 2009, the Family Smoking Prevention and Tobacco Control Act was passed granting the Food and Drug Administration the authority to regulate tobacco products.[55] Among the states, North Carolina recently passed tobacco control legislation to ban cigarette smoking in restaurants as of January 20, 2010.[56] Of the 50 states in America, 50% of the U.S. population was protected by some combination of Clean Air policies as of 2008.[57] Recent tobacco control acts undoubtedly changed who is exposed to cigarette smoke and at what rate.

Another limitation of the data is that NHANES protocol allows for half–mouth data collection, with limited periodontal reading sites per tooth during the periodontal assessment. However, officials at the CDC concede that this abbreviated assessment protocol under reports periodontitis prevalence.[58] The periodontal assessment protocol changed throughout the 5 years of data collection reported in this study, therefore, collected data were reduced to the 2 common sites per tooth. Additionally, NHANES reports that trained dentists performed the periodontal assessments, but no kappa score is reported for intra–rater reliability. The questionnaires and testing methods do not identify in which locale the participants were exposed to second

Table III: Multivariable analysis modeling odds ratio and 95% confidence interval for moderate or severe periodontitis[a] in dentate non–smoking U.S. adults aged ≥20 years[b] (n=2,998), NHANES 1999 to 2004

Characteristic	OR (95% CI)
Sex	
Male	1.17 (0.65, 2.12)
Female	Ref
Age in years	1.08 (1.06, 1.10)
Race/ethnicity (c)	
Non–Hispanic white	Ref
Non–Hispanic black	2.52 (1.35, 4.71)
Hispanic	1.70 (0.81, 3.58)
Educational attainment	
Less than high school education	2.74 (1.45, 5.21)
High school graduate or equivalent	1.82 (0.89, 3.71)
Some college or more education	Ref
Annual family income	
<$25,000	1.79 (0.68, 4.70)
$25,000–<$75,000	1.42 (0.57, 3.56)
≥$75,000	Ref
Serum cotinine concentration	
<0.05 ng/mL	Ref
0.05 – <0.15 ng/mL	1.16 (0.62, 2.18)
≥1.5 ng/mL	1.89 (1.08, 3.31)

[a]CDC/AAP case classification for moderate or severe periodontitis defined as ≥2 interproximal sites with clinical attachment level ≥4 mm, not on the same tooth, or ≥2 interproximal sites with probing depth ≥5 mm, not on the same tooth
[b]Results are adjusted for year of NHANES survey
[c]Persons identifying racially as "Other" were omitted from this analysis due to the small number of these subjects (n=39)

Figure 1: Predicted probability and 95% confidence interval of having moderate or severe periodontitis according to level of serum cotinine and adjusted for age, sex and year of NHANES, in dentate non–smoking U.S. adults aged ≥20 years (n=3,137), NHANES 1999 to 2004
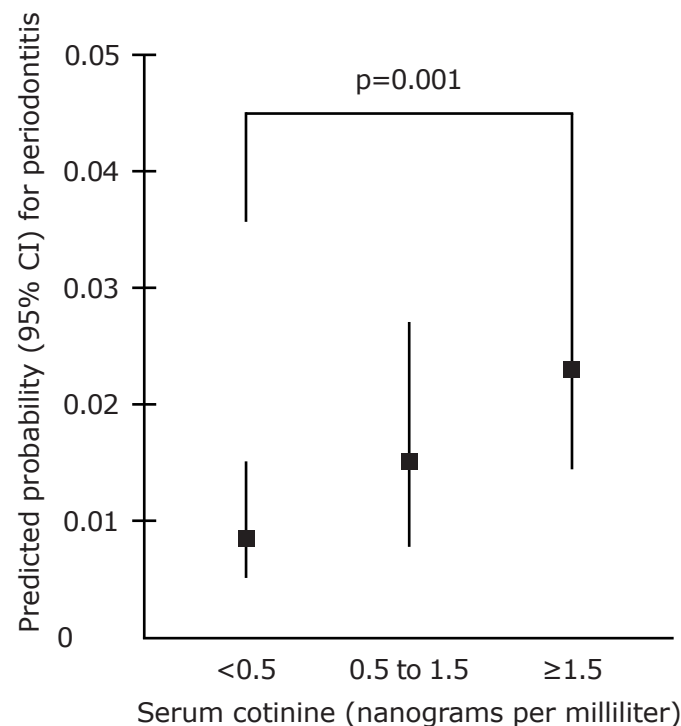
Periodontitis is defined using the CDC/AAP case classification for moderate or severe periodontitis: either ≥2 interproximal sites with clinical attachment level ≥4 mm, not on the same tooth, or ≥2 interproximal sites with probing depth ≥5 mm, not on the same tooth

hand smoke. For this reason, it is difficult to know which improvements should be made to tobacco control policy.

Unexpectedly, the threshold of harmful exposure differed between racial groups. For example, from the same exposure, non–Hispanic blacks absorb 30% more cotinine than do non–Hispanic whites.[47] Greater absorption of ETS may explain why non–Hispanic blacks were more likely to have periodontitis than non–Hispanic whites. Also unexpected was the finding that younger adults were less likely to have periodontitis while being more exposed to cotinine, however, age is an associated risk factor for periodontitis due to lifetime disease

and CAL accumulation.[16,59] The increased exposure in younger adults could be due to lifestyle differences, exposure environments and personal oral hygiene habits.[47]

Studies have previously linked cigarette smoking to race, as well as social gradients in periodontitis.[48,60,61] Therefore, the strong gradient found between income level and cotinine exposure, as well as the one found between education level and exposure, were expected.[62,63] In general, the study methods used here could be implemented in any other nationally representative examination. This study echoes the finding of income, education and race gradients between exposure and disease. It also confirms that tobacco control bans are beneficial[64,65] and should increase in the future as they decrease public smoking and the permeation of environmental tobacco smoke. Future research could evaluate in what specific ways public smoking bans are beneficial to non–smoking, at–risk populations.

Currently, psychological tools and assessment instruments are used to encourage meaningful and motivated behavior change in patients, as well as increase provider confidence in providing cessation techniques.[66,67] This study has strong and timely implications for dental hygiene practice. An update on clinical practice guidelines regarding smoking cessation counseling estimated a 2–fold increase in smoking cessation counseling since the early 1990s, as well as a steadily decreasing rate of smokers.[68] Multiple controlled trials report efficacy in tobacco cessation counseling,[67–69] indicating that moments shared by patients and providers in dental care settings are teachable moments,[70] and that patients listen and are encouraged by the focus on individualized oral health. For instance, patients are more likely to approach tobacco behavior change in response to existing oral complaints such as tooth color or oral malodor that can be associated with smoking.[71] For that reason, as well as the documented link between cigarette smoke and systemic disease,[72-74] this study is crucial.

Dental hygienists are in a powerful position to affect future behaviors of patients by utilizing those teachable moments to relate to patients and identify those at risk. Research demonstrates that flexibility in tobacco education curriculum encourages incorporation of tobacco education in dental hygiene programs.[75] In an ever expanding body of research, the curriculum should expand to include the most recent evidence – that ETS affects the periodontal health of even non–smoking patients. This, along with continued research, could further strengthen the education provided to patients as well as the confidence with which it is delivered.[76]

The strong relationship found between serum cotinine and increased odds of periodontitis provides evidence that mere smoking cessation counseling is not enough. Education about risk of cigarette smoke should also express the risk of passive smoke exposure. This finding holds importance for health care providers in a position to advise and educate patients. Since a large percentage of those unwillingly exposed to second hand smoke are children, an effort to inform parents though public health initiatives and stronger tobacco control policies for homes and cars would be valuable.[77]

In the future, similar studies with more recent release dates are needed to compare the differences in exposure to non–smokers as tobacco control policy increases. Sub–grouped participants in areas of high tobacco control, moderate and low areas of tobacco control would further identify the benefit of reducing exposure, particularly in areas with disadvantaged populations. Due to the strong socioeconomic gradients, studies of the knowledge and opinions about passive smoke of at–risk groups could illuminate shortcomings in education to protect those most at risk of exposure and help to advance tobacco control policies.

Conclusion

Cigarette smoke is harmful to periodontal health, whether exposure is voluntary or involuntary. ETS is implicated in a list of diseases that mirrors those caused by firsthand smoke, with a similar mechanism of action. For measurement of environmental exposure, especially in non–smokers, the mechanism of choice is isolation of cotinine in bodily fluids such as serum, saliva and urine.

Of the impacted diseases, periodontitis is one of importance. This study proposed to examine the relationship between objectively measured exposure to environmental tobacco smoke and periodontitis. By and large, the Americans most affected by both smoke and disease are those in the lower socioeconomic classes, namely low income, low education and minority groups. Ultimately, roughly half the non–smokers sampled were exposed to ETS, and their exposure was significantly associated with 2–fold risk of periodontitis.

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Disclosure

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Effect of Scaling and Root Planing on Erythrocyte Count, Hemoglobin and Hematocrit in Patients with Chronic Periodontal Disease

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Introduction

Despite substantial improvement in the oral health status of populations across the world, periodontal disease still remains a significant social burden. Periodontal diseases are the end result of the host response to complex actions of a group of periodontal bacteria, predominantly gram–negative anaerobes. Accumulating evidence on the role of periodontal diseases on general health has related chronic periodontal inflammation to various systemic diseases, diabetes mellitus being the most consistent.[1] On the other hand, the aggravating effect of periodontal diseases on cardiovascular diseases, pre–term and/or low birth weight, stroke, pneumonia and anemia has been clinically observed.[2–15]

The association between anemia and periodontal disease has been explored since the 20th century. Available literature indicates a 2–way relationship with some reports suggesting anemia to be a cause of destructive periodontal disease, whereas others suggest it is a consequence of it. Siegel et al reported depression in the number of erythrocytes apparently secondary to the presence of periodontal disease.[8] Various authors in the literature have substantiated these findings.[9–13,15] However, little was known at that time about the reasons for the hematological alterations. Lainson was one of the first authors to implicate anemia as a systemic cause of periodontitis.[16]

Abstract

Purpose: Anemia of chronic disease, a cytokine–mediated anemia, is a frequent complication of many chronic inflammatory conditions. The present clinical trial was aimed to evaluate the effect of chronic periodontal disease on erythrocyte count, hemoglobin and hematocrit and the changes produced in these parameters after the provision of periodontal therapy.

Methods: 40 systemically healthy non–smoker male subjects in the age group of 25 to 50 years suffering with chronic periodontal disease were selected and categorized into 2 groups. Group A was categorized as chronic generalized gingivitis, and Group B was categorized as chronic generalized periodontitis on the basis of clinical findings. The clinical parameters Gingival Index (GI), Probing Pocket Depth (PPD) and Relative Attachment Level (RAL) and laboratory blood investigations viz erythrocyte count (EC), hemoglobin (Hb), hematocrit (HCT) and red cell indices (MCV, MCH, MCHC) were recorded at baseline. Complete oral prophylaxis was performed for all patients. Patients were recalled after 3 weeks and 3 months. The clinical and hematological parameters were re–evaluated to analyze the changes after provision of phase I therapy.

Results: The mean values of EC, Hb and HCT were significantly lower in Group B in comparison to Group A, and showed a significantly greater increase at 3 months of observation. However, the values of MCV, MCH and MCHC showed a non significant change during the same observation period in both the groups.

Conclusion: Lower values of EC, Hb and HCT in Group B showed that mild anemia is associated with chronic generalized periodontitis, which tends to improve after provision of periodontal therapy. Minimal changes in MCV, MCH and MCHC indicated that the lower values are not due to any vitamin and mineral deficiencies, but secondary to the chronic inflammatory changes associated with chronic periodontal disease.

Keywords: Chronic periodontal disease, periodontitis, anemia, erythrocyte count, hemoglobin, hematocrit, inflammation, cytokines

This study supports the NDHRA priority area, **Health Services Research:** Evaluate strategies that position and gain recognition of dental hygienists as a primary care providers in the health care delivery system.

Mechanical debridement has been the cornerstone for professional plaque control and prevention of periodontal disease for centuries.[17] It aims not only to preserve periodontal tissues, but also to limit the oral source of inflammation contributing to overall systemic well–being.

Periodontal medicine defines a rapidly emerging branch of periodontology focusing on establishing a strong inter–relationship between periodontal disease and systemic health and offering new insights of the oral cavity as one system interconnected with the whole human body.[18] Most of the studies undertaken in the past to clarify the association between periodontal diseases and the lowered hematological parameters were either cross–sectional or longitudinal, and described only the co–existence of the 2. Thus, the present interventional trial was carried out to discover if the improvement in periodontal status after periodontal therapy could result in any alteration of the lowered hematological parameters.

Methods and Materials

Subject Selection

The study was carried out as a parallel, 2 group clinical interventional trial. The study design was approved by the Medical Ethical Committee of National Dental College & Hospital, Derabassi.

The study population consisted of 40 systemically healthy non–smoker male subjects suffering with chronic periodontal disease in the age group 25 to 50 years visiting the Department of Periodontology and Oral Implantology, National Dental College and Hospital, Derabassi (Punjab). The criteria for inclusion were:

1. Suffering with generalized chronic periodontal disease
2. No history of antibiotic intake for the last 3 months prior and during the course of the study
3. No history of blood loss in the recent past. No history of any minor or major trauma, any oral or general surgical procedure, which could have resulted in blood loss
4. No history of any periodontal treatment at least 6 months before the commencement of the study
5. No history of blood transfusion and/or donation 3 months prior and during the course of the study
6. Patients showing cooperation for the treatment

The study subjects were categorized into 2 groups of 20 patients each. Group A (Chronic Generalized Gingivitis, n=20) was described as showing clinical signs of gingivitis. Changes in color, contour, consistency, texture and bleeding on probing and probing pocket depth ≤3 mm. Group B (Chronic Generalized Periodontitis, n=20) was described as having probing pocket depth ≥5 mm and clinical attachment loss ≥3 mm. The selected subjects were verbally informed about the study protocol and asked for their voluntary participation.

Study Method

The gingival and periodontal status was evaluated for each patient using the following clinical parameters:

- Gingival Index – Loe and Silness,[19] 1963
- Probing Pocket Depth – William's Periodontal Probe (Hu Friedy, Chicago, Ill.)
- Relative Attachment Level (only for Group B) – CPITN probe with customized acrylic stent (Hu Friedy, Chicago, Ill.)

Collection of Blood Sample

After recording the clinical parameters, 5 ml of venous blood was drawn under aseptic conditions, from the ante cubital fossa. The drawn blood was transferred immediately to EDTA containing vacutainers to be transported to the medical laboratory. The estimation of the following hematological parameters was done using fully automated cell analyzer–Sysmex K21 analyzer:

- Total erythrocyte count (EC)
- Hemoglobin level (Hb)
- Hematocrit (HCT)
- Mean Corpuscular Volume (MCV)
- Mean Corpuscular Hemoglobin (MCH)
- Mean Corpuscular Hemoglobin Concentration (MCHC)

Thorough full mouth scaling and root planing was performed for all the patients using hand and ultrasonic instruments.

The patients were given oral hygiene instructions and instructed to brush twice daily and use mouth rinse with 0.12% Chlorhexidine digluconate twice daily for plaque control. The patients were advised not to take any iron or vitamin supplements, and were asked not to make any modifications in their diet during the course of study. The patients were recalled after 3 weeks and 3 months for reevaluation of all the clinical and hematological parameters. Oral hygiene instructions were reinforced at each follow up visit.

Statistical Evaluation

The data obtained was compiled and analyzed using SPSS Inc., version 15.0 for Windows. Mean and standard deviation for all parameters were calculated. The statistical significance of differences in independent variables for the intra–group measurements were analyzed by using student t–test (2 tailed, paired) and for inter–group measurements over time were tested according to student t–test (2 tailed, independent). The data was found to be normally distributed as analyzed with one sample Kolmogorov–Smirnov test and hence paired t–test was applied. A 2 tailed probability value (p–value) <0.05 was considered as statistically significant and p–value≤0.01 considered as highly significant. A p–value>0.05 was considered as non–significant

Results

The study population consisted of 20 males with a mean age of 27.6 years (age range: 25 years to 43 years) for Group A, and a mean age of 36.5 years (age range: 28 years to 50 years) for Group B. In Group A, all the 20 patients completed the follow up at 3 weeks and 3 months. In Group B, 17 patients completed the study, however, 3 patients did not return at the 3 month follow up due to unknown reasons. Data from these patients was excluded.

Baseline data of the total study population has been summarized in Table I. Data analysis revealed that the values of clinical parameters viz. GI and PPD were higher in Group B in comparison to Group A. In Group A, at baseline, 35% and 25% of subjects were below laboratory reference range (Figure 1) for erythrocyte count and hematocrit, respectively, whereas in Group B 75% of subjects were below reference range for erythrocyte count and hemoglobin, and 55% for hematocrit (Table II and III). The values of red cell indices viz. MCV, MCH and MCHC were comparable in both the groups and were within the normal reference range.

Analysis Of Clinical Parameters

The clinical and hematological parameters at 3 weeks and 3 months of observation for Group A and Group B have been summarized in Table I.

Gingival Index (GI)

In Group A, the mean reduction in GI from baseline to 3 months was 0.24±0.29, which was statistically significant. In Group B, a statistical significant reduction of 0.32±0.18 in GI was observed from baseline to 3 months. When Group A and Group B were compared for change in GI at different periods of observation, a statistically non–significant differ-

Table I: Showing mean values of clinical parameters and hematological values at baseline, 21 days and 3 months in Group A and Group B

Clinical Parameters	Group A	Group B
Gingival Index		
GI1	1.64±0.23	2.30±0.24
GI2	1.40±0.24	2.04±0.27
GI3	1.40±0.35	1.99±0.32
Probing Pocket Depth (in mm)		
PPD1	2.36±0.29	4.94±0.39
PPD2	2.11±0.27	4.64±0.29
PPD3	2.10±0.30	4.48±0.32
Relative Attachment Level (in mm)		
RAL1		9.07±0.76
RAL2	–	8.60±0.44
RAL3		7.88±0.78
Hematological Parameters	Group A	Group B
Erythrocyte Count (X 10^6/µL)		
EC1	4.60±0.42	4.06±0.61
EC2	4.61±0.34	4.15±0.55
EC3	4.70±0.40	4.28±0.46
Hemoglobin (g/dl)		
Hb1	14.29±0.65	12.77±2.02
Hb2	14.43±0.65	12.87±1.93
Hb3	14.60±0.81	13.08±1.95
Hematocrit (%)		
HCT1	42.72±3.29	39.34±5.10
HCT2	42.58±3.19	39.73±5.00
HCT3	43.23±3.14	39.75±4.89
Mean Corpuscular Volume (fl)		
MCV1	92.99±7.37	93.83±6.55
MCV2	92.57±6.25	93.77±6.67
MCV3	92.46±7.14	92.75±8.02
Mean Corpuscular Hemoglobin (pg)		
MCH1	31.38±2.22	30.93±3.46
MCH2	31.51±1.68	31.09±3.20
MCH3	31.21±1.79	30.82±3.65
Mean Corpuscular Hemoglobin Concentration (g/dl)		
MCHC1	33.42±1.47	32.66±1.96
MCHC2	33.88±2.72	32.31±2.60
MCHC3	33.74±2.58	33.40±2.06

ence was observed between the 2 groups.

Probing Pocket Depth (PPD)

In Group A, the mean reduction in pocket depth from baseline to 3 months was observed to be 0.25±0.27 mm, which was statistically significant, whereas, in Group B, the mean reduction in pocket depth from baseline to 3 months was 0.43±0.22 mm, which was also statistically significant. When Group A and Group B were compared for change in pocket depth a significantly greater reduction was present in Group A when compared to Group B from baseline to 3 months.

Relative Attachment Level (RAL)

In Group B, a mean gain in RAL from baseline to 3 weeks and baseline to 3 months was observed at 0.47±0.44 mm and 1.14±0.76 mm, respectively, which was statistically significant at both periods of observation.

Analysis of Hematological Parameters

Erythrocyte Count (EC)

In Group A, an increase of 0.09±0.22 X10^6/µL was noted in EC from baseline to 3 months, which was not statistically significant. In Group B, the increase in EC from baseline to 3 months was observed to be 0.30±0.39 X10^6/µL, which was statistically significant. When Group A and Group B were compared for change in EC, a statistically significant difference in improvement was observed for Group B in comparison to Group A at 3 weeks to 3 months of observation.

Hemoglobin (Hb)

In Group A, an increase of 0.31±0.57 gm/dl was observed in Hb concentration from baseline to 3 months, which was statistically significant. In Group B, an increase of 0.53+0.69 gm/dl was recorded, which was statistically significant. When Group A and Group B were compared for change in Hb concentration, a statistically significant difference in improvement was observed for Group B in comparison to Group A during the observation period of 3 weeks to 3 months.

Hematocrit (HCT)

Table II: Table showing descriptive analysis showing distribution of hematological parameters based upon laboratory reference range for Group A

Group A	Baseline			3 months		
	Normal	Abnormal	% below reference	Normal	Abnormal	% below reference
Erythrocyte count	13	7	35%	15	5	25%
Hemoglobin	20	–	–	20	–	–
Hematocrit	15	5	25%	17	3	15%

Table III: Table showing descriptive analysis showing distribution of hematological parameters based upon laboratory reference range for Group B

Group B	Baseline			3 months		
	Normal	Abnormal	% below reference	Normal	Abnormal	% below reference
Erythrocyte count	5	15	75%	6	11	65%
Hemoglobin	5	15	75%	14	3	18%
Hematocrit	9	11	55%	9	8	47%

Figure 1: Normal hematological values (for adult males)

COMPONENT	REFERENCE VALUES (in conventional units)
Erythrocyte count	4.5–6.5 X 106/µL
Hemoglobin	11.5–16.5 g/dl
Hematocrit	40–54%
MCV	77–93fl
MCH	27–32 pg
MCHC	30–35 g/dl

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In Group A, the mean change in HCT from baseline to 3 months was observed to be 0.46±1.72, which was not statistically significant. In Group B, an increase of 0.52±1.01 was observed in HCT from baseline to 3 months was statistically significant. When Group A and Group B were compared for change in HCT at different periods of observation, a statistically non–significant change was observed.

Red Cell Indices: Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC)

In Group B, a statistically significant difference in improvement was observed between mean values of MCHC at 3 weeks to 3 months interval. However, a non–significant change was observed in MCV, MCH at different periods of observation. In Group A, a statistically non–significant change was observed in

MCV, MCH and MCHC at different periods of observation.

A significant difference in improvement was observed with respect to MCHC in Group B when compared to Group A between 3 weeks and 3 months of observation.

The results of descriptive analysis showing distribution of hematological parameters based upon laboratory reference range for Groups A and B have been tabulated in Table II and III, respectively.

Discussion

The mouth is the mirror of health and disease, as a sentinel or early warning system, as an assessable model for the study of other tissues or organs and as a potential source of pathology affecting other systems and organs. The concept of periodontal diseases as localized entities affecting only the teeth and supporting apparatus has been revised, as it has been seen that rather being confined to the periodontium, periodontal diseases have wide ranging systemic effects. Periodontal disease has a potential relationship with several systemic conditions like cardiovascular diseases, diabetes mellitus, adverse pregnancy outcomes, obesity and stroke.[1–6] One of the lesser–documented associations has been the inter–relationship between periodontal disease and anemia.

Anemia of chronic disease (ACD) is an immune driven process in which cytokines result in decreased erythropoietin production, impaired proliferation of erythroid progenitor cells and disturbed iron homeostasis.[20,21] This normocytic and normochromic anemia has been described in many chronic diseases like rheumatoid arthritis, renal failure, bacterial and parasitic infections, and chronic periodontitis, among others.

An interventional study was planned to measure the effects of scaling and root planing on EC, Hb and HCT in patients with chronic periodontal disease. This study design was preferred over cross–sectional and longitudinal study, as it could clearly delineate that resolution of periodontal inflammation could influence general health by improving metabolic control and endothelial function.

The study population consisted of 40 adult males of Asian Indian origin and excluded females, tobacco smokers and chewers, patients on antibiotics and with recent history of blood loss, as these characteristics can act as possible confounding factors that could alter the hematological factors. Females were excluded as they undergo physio-

logical blood loss and cyclic hormonal imbalance, which is responsible for an altered and exaggerated response to local factors. Gokhale et al reported that in India, anemia is more prevalent in females due to poor nutrition, increased menstrual losses, high incidence of tropical and intestinal infections and other miscellaneous factors.[13] Erdemir et al suggested that smokers with chronic periodontitis had lower number of erythrocytes, lower value of Hb, HCT and iron as compared to nonsmokers with chronic periodontitis.[22]

Clinical parameters GI, PPD and RAL were included in the study for the assessment of the inflammatory state of the gingival tissues, the progression of the periodontal disease and the therapeutic effect of the treatment i.e. scaling and root planing. The hematological parameters total EC, Hb, HCT, MCV, MCH and MCHC were selected for evaluation, as these are indicative of the anemic state of the patient and also the type of anemia based on morphology of the cell.[9,15]

The baseline analysis of the hematological parameters of the total study population revealed that in Group A, 35% and 25% of the subjects had values of EC and HCT below the normal laboratory reference range, while the values of all other hematological parameters were within normal laboratory reference range (Figure 1). In Group B, the values of EC, Hb and HCT were below the laboratory reference range in 75% and 55% of subjects, respectively, and were lower as compared to Group A, whereas the values of the red cell indices viz. MCV, MCH and MCHC were within the normal reference range. These findings were similar to as reported by Erdemir who stated some differences between the "healthy" and "periodontitis" groups in the erythrocytes, Hb, and hematocrit values in the peripheral blood, though they were within the reference range for a given parameter in the groups.[22] Similar findings have been reported by Hutter et al,[15] Yamamotu et al,[20] Gokhale et al,[13] Lainson et al,[16] Thomas[12] and Loos.[23] However, Salvi[24] and Zeibolz[25] observed a lack of correlation between anemia and periodontitis.

The subgingival organisms and their products have the potential to enter the blood stream and affect distant sites through the ulceration in the pocket epithelium, and thus evoke low grade systemic inflammation.[9,15,20] Pro–inflammatory cytokines such as TNF–α, IL–1β, INF–γ and PGE$_2$ are found in high concentrations in inflamed periodontal tissues, and have been related to the suppression of erythropoeisis.[20,22,25–31] Johnson et al exposed mice to a single intravenous dose of TNF–α, which resulted in suppression of spleen and mar-

row erythroid colony forming units (CFU–E).[26] Also, Faquin et al reported that IL–1 (α or β), TNF–α and TGF–β inhibited production of erythropoeitin hormone which is responsible for the regulation of erythropoeisis.[26] Also, periodontal inflammation often results in bleeding from gingiva. Therefore, direct loss of blood might also be responsible for the reduction in number of erythrocytes, but this has not been substantiated with evidence. These are a few plausible mechanisms explaining for decreased values of hematological parameters in patients with periodontitis.[13,20,26]

A significant improvement in the clinical parameters was evident by reduction in the scores of GI, decrease in the PPD in both groups and gain of attachment in the chronic generalized periodontitis patients at the 3 month follow up after phase I therapy from the baseline. This could be attributed to effective mechanical debridement, which was aimed at reduction in the bacterial load, as a result of which the local inflammation decreased significantly.

After 3 months of the periodontal therapy, there was a reduction in percentage of subjects who were below reference range of normal hematological values. In Group A, 25% and 15% of subjects were below reference range for EC and HCT, respectively, whereas in Group B, EC, Hb and HCT were below the reference range in 65%, 18% and 47% of subjects, respectively. A statistically significant improvement of 0.31 million/mm3 was noted in the patients with chronic generalized periodontitis with respect to the EC at the end of the 3 month follow up after the phase I therapy. The results are in accordance with the results of previous studies carried out by Rai[32] and Aggarwal et al,[9] who showed a significant improvement of 0.1 and 0.22 million/mm3, respectively, in EC after the periodontal therapy.

Both groups showed a statistically significant improvement in the Hb concentration at the end of the 3 month follow up after phase I therapy. This rise suggested that the anemia present was secondary to periodontal disease as it improved subsequent to periodontal therapy. The results of the present investigation are favorably comparable to the study carried out by Rai et al, who found a statistically significant increase in the mean hemoglobin level of 14.5 mg/dl at baseline to 15 mg/dl at 10 weeks after scaling and root planing.[32] The findings are also in agreement with the study by Aggrawal, which showed a mean increase in mean Hb value by 0.95g/dl at the end of a 1 year follow up.[9] The variation in the results could possibly be attributed to the longer period of study, where follow up continued for a period of 1 year and surgical treatment was carried out wherever necessary. However, studies by Wakai et al[33] and Havemose–poulsen et al[34] failed to show any association between Hb levels and periodontal status.

A statistically significant improvement was observed in the HCT of patients with chronic generalized periodontitis at the end of the 3 month follow up after phase I therapy with respect to baseline. A similar trend for improvement of HCT was observed in chronic generalized gingivitis patients as well, but the difference observed was statistically non–significant with respect to baseline.

A significant improvement was seen in mean corpuscular Hb concentration in patients with chronic generalized periodontitis at the end of 3 months after the periodontal therapy. Mean corpuscular volume and mean corpuscular Hb followed a statistically non significant rise after the periodontal therapy in both groups. The small increment of change in mean corpuscular Hb and mean corpuscular Hb concentration values compared to increase in Hb levels implied that anemia associated with periodontitis is of normochromic type.[2,30,32] MCV levels are the main determinants of certain types of anemia. A depressed level of MCV (microcytosis) relates anemia to iron deficiency and elevated level of MCV (macrocytosis) relates anemia to vitamin deficiency. In our study, MCV levels were between the reference values as mostly seen in ACD and called as normocytosis. This indicated that anemia due to chronic periodontitis is not due to vitamin or mineral deficiencies, but secondary to the inflammatory changes present in periodontitis.

It was observed that the values of EC, Hb and HCT in patients with chronic generalized gingivitis were higher than the chronic periodontitis patients and were within the laboratory reference range. Also, the changes observed in this study with respect to EC, Hb and HCT are statistically significant in the chronic periodontitis patients as compared to chronic gingivitis patients. The difference could be attributed to the amount of inflammatory response elicited by the periodontitis in comparison to gingivitis. It is important to note that the difference in the hematological parameters in chronic periodontitis was not as striking as observed in anemia due to other inflammatory conditions like rheumatoid arthritis, bacterial and parasitic infections and multiple myeloma. This could be due to the reason that the other diseases are more severe inflammatory conditions than periodontitis as observed by the more severe immune response evoked by them.

Within the limitations of the present study, it can be stated that chronic periodontal diseases lead to alteration in the hematological parameters EC, Hb and HCT, which showed an improvement after the provision of periodontal therapy. The present interventional study has paved the path for future studies, with a larger study population for a longer period of time to further validate the association between periodontal disease and anemia.

Conclusion

The following conclusions were arrived at from this study:

1. Chronic generalized periodontitis being a more chronic and long standing infection resulted in greater depression in the values of hematological parameters in comparison to chronic generalized gingivitis.
2. A highly significant improvement was observed with respect to Hb concentration, EC and HCT in the patients with chronic generalized periodontitis at the end of the 3 month follow up after phase I therapy with respect to baseline. The improvement observed in the patients with chronic periodontitis was significantly greater than chronic generalized gingivitis patients.
3. Non significant changes in the values of MCV, MCH and MCHC indicated that the decreased red cell counts are not due to any vitamin or mineral deficiency, but secondary to the inflammatory changes induced by periodontal diseases.

The emerging field of periodontal medicine offers new insights into the concept of the oral cavity as 1 system interconnected with the whole human body.[32] If this notion is believed to be accurate, we need to assume a larger responsibility apart from diagnosing and treating the periodontal infections, and also educate the public about the importance of oral health in the overall systemic well being. With the resurgence of emphasis on significance of oral disease related to systemic health, the medical professionals also need to familiarize themselves with the oral cavity and the oral–systemic relationships to treat or reduce the morbidity of the underlying medical condition. Oral health care professionals must reach out to the medical community and the general public to improve patient care through education and communication about the perio–systemic link.

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Effects of Periodontal Instrumentation on Quality Of Life and Illness in Patients with Chronic Obstructive Pulmonary Disease: A Pilot Study

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Introduction

Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death in the world, and the World Health Organization predicts it will become third by 2030.[1] In 2007, the prevalence of COPD worldwide was reported to be 10.1%.[2] There are 2 main forms of COPD: chronic bronchitis and emphysema.[3] Researchers have identified a possible relationship between periodontal disease and COPD. Studies have suggested:

1. People with poor periodontal health are at increased risk for COPD[4–7]
2. Those with more advanced periodontitis have more severe COPD[7–9]
3. Individuals with COPD have greater alveolar bone loss and clinical attachment loss (CAL) than those without COPD[4,9,10]

Smoking may be a cofactor in the association between COPD and periodontal disease because it plays a significant role in the etiology of both diseases.[11] While an association between these 2 chronic diseases has been identified, a causal association has not been proven.[12,13]

In a systematic review published in 2007, Azarpazhooh et al reported that evidence existed to support an association between pneumonia (acute respiratory infection in the lung) and oral health.[13] However, little evidence existed supporting a weak association between COPD and

Abstract

Purpose: To assess if patients with chronic obstructive pulmonary disease (COPD) receiving periodontal debridement for treatment of chronic periodontitis with ultrasonic or hand instrumentation experienced changes in quality of life or incidents of illness following treatment or no treatment.

Methods: The study design was a 3 group, randomized, controlled pre– and post–test experimental pilot study. Volunteers with COPD and chronic periodontitis (n=30) were recruited from physician offices or fliers and randomly assigned to 1 of 3 groups. Of those, 2 groups had periodontal debridement using either magnetostrictive ultrasonic instrumentation (n=10) or hand instrumentation (n=10). A control group (n=10) received no treatment. Primary outcomes, quality of life and illness were measured by the St. George's Respiratory Questionnaire (SGRQ–A) and Illness Questionnaire, respectively. Subjects completed the questionnaires as pre–tests at baseline and as post–tests 4 weeks post–treatment/no treatment. Repeated measures ANOVA was used to compare groups on continuous variables (p≤0.05) measured by SGRQ–A total scores and symptoms, activities and impacts subscales. Percentages, frequencies and cross tabulations were calculated for categorical data.

Results: SGRQ–A and Illness Questionnaire scores showed no significant differences between groups in quality of life or illness following periodontal debridement. Total SGRQ–A scores decreased slightly for all groups with no significant difference among groups (p=0.138) and no interaction (p=0.794). Cross tabulations showed no relationship between indicators of self–reported illness before and after treatment/no treatment. No adverse events were reported.

Conclusion: Based on this small–scale study, it seems periodontal debridement for chronic periodontitis has no effect on quality of life and illness in patients with COPD, and it may be performed with ultrasonic or hand instruments without adverse events.

Keywords: Pulmonary disease, chronic obstructive (COPD), chronic periodontitis, quality of life, periodontal debridement, non-surgical, scaling and root planing, randomized controlled trial

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

oral health with an odds ratio of less than 2.[13] Studies published since the review by Azarpazhooh et al indicate an association between poor periodontal health and respiratory disease. These findings support a trend toward a fair association between COPD and periodontal health.[4,7,9,10] One type of pneumonia studied is hospital–acquired, or nosocomial, pneumonia. Studies have concluded that inadequate oral hygiene resulting in accumulation of dental plaque biofilms may promote oropharyngeal colonization of respiratory pathogens, which increase the risk for lower respiratory tract infections, including pneumonia, in hospitalized patients with weakened host response.[14,15]

It is speculated that aspiration of these oropharyngeal secretions, containing respiratory pathogens, can result in acute respiratory infection known as aspiration pneumonia.[3] Additionally, studies have reported that microorganisms associated with denture plaque or periodontal disease may give rise to aspiration pneumonia in susceptible individuals, and prevalence of anaerobic bacteria in the oral cavity may increase the incidence and prognosis of aspiration pneumonia.[16-18] A longitudinal study of elders over age 80 found the adjusted mortality from pneumonia was 3.9 times higher in persons with 10 or more teeth with probing depths greater than 4 mm.[18] Other studies have shown professional oral health care (i.e., chemical and/or mechanical plaque control) reduced the prevalence of acute respiratory infections.[19,20] Population samples in these studies included only high–risk individuals in hospitals or long–term care facilities. A systematic review designed to assess the preventive effect of oral hygiene on pneumonia and respiratory tract infection indicated mechanical oral hygiene has a preventive effect on mortality from pneumonia and non–fatal pneumonia in hospitalized elderly or those living in nursing homes, reducing death from pneumonia by approximately 1 in 10 cases.[21]

In their systematic review, Azarpahzooh et al concluded there is good evidence that oral pharyngeal decontamination with antimicrobials reduces the incidence of pneumonia, and also concluded that frequent professional oral health care slows the progression or decreases occurrence of respiratory diseases in high risk elderly adults in hospitals and nursing homes.[13] Results from 2 randomized clinical trials revealed weekly oral hygiene care provided by dental hygiene professionals (scaling and mechanical plaque control), with and without tooth brushing after every meal with 1% povidone iodine, reduced frequency of pneumonia, respiratory tract infections and fatal pneumonia in dependent elders.[22,23] Studies utilizing data from National Health and Examination Surveys I and III, controlled for possible confounders, documented an association between oral hygiene and chronic respiratory disease.[6,24] Findings from a multicenter, case–control study of ambulatory patients with COPD concluded that promoting oral health knowledge and regular dental visits/supragingival scaling should be integrated components of strategies for prevention and treatment of COPD.[4] A recent study found that periodontal parameters (missing teeth and plaque scores) were significantly associated with lower quality of life in COPD patients, as measured by the St. George's Respiratory Questionnaire (SGRQ).[25] These results and findings of studies regarding aspiration pneumonia support the importance of oral hygiene for people with histories of acute and chronic respiratory diseases.

Mechanical debridement by ultrasonic or hand instruments has been shown to be equally effective in improving clinical parameters in periodontal therapy.[26-28] Ultrasonic devices create significant aerosols contaminated with oral bacteria.[29-31] A longitudinal study of U.S. veterans identified an association between number of functional dental units present, presence of Staphylococcus aureus, Streptococcus sobrinus and Porphyromonas gingivalis, and aspiration pneumonia in dentate patients with a history of lower respiratory tract infections.[17] Porphyromonas gingivalis is a well–known periodontal pathogen. There is documented concern in textbooks regarding use of ultrasonic instrumentation for patients with respiratory disease based on concern about possible aspiration of pathogenic bacteria during treatment.[32-34] Manufacturers (e.g., Cavitron® Jet Plus™, Dentsply International, York, PA) recommend physician consultation regarding disease status prior to air polishing for severe respiratory disease. Anecdotal evidence suggests dental practitioners routinely use ultrasonic devices to treat periodontal disease, despite presence of COPD. Little is known about patient safety and risks, such as post–treatment illness or treatment impacts on quality of life, associated with potentially aspirated bacteria during hand or ultrasonic instrumentation for these patients.

No studies were found in the literature that studied the effects of periodontal therapy on chronic lung diseases in high–risk individuals with periodontal disease, although these conditions commonly co–exist. The purpose of this study was to assess if patients with COPD and chronic periodontitis had a change in their health–related quality of life or self–reported illness following nonsurgical periodontal therapy with ultrasonic or hand instrumentation.

Methods and Materials

The study design was a 3 group, randomized, controlled pre– and post–test experimental pilot study. Human subject approval was granted from

the Idaho State University Human Subjects Committee institutional review board and the Portneuf Medical Center institutional review board. The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. All subjects gave informed consent to participate. The principal investigator, a licensed dental hygienist, performed the oral examination, informed consent process and treatment procedures.

Study Population

A convenience sample of 30 subjects was recruited from physician offices or by distributed fliers between January 2009 and February 2010. Recruitment included a diagnosis of COPD from medical databases. These patients were contacted by their medical provider via telephone calls or letters, depending on the preference of each participating physician office, to determine interest in the study and relay study contact information to interested individuals. In addition, fliers were posted in various approved medical and dental facilities. Once contacted, the principal investigator determined initial eligibility of sample participants based on predetermined criteria via telephone interview (e.g., presence of natural teeth, no dental treatment in preceding 6 months and/or no antibiotics preceding 3 months). Individuals meeting initial eligibility criteria were invited for an oral examination appointment to establish continued eligibility for participation.

Potential subjects signed HIPAA acknowledgement and release forms prior to oral examination. Assessment included medical history review, vitals (blood pressure, pulse, respirations and pulse oxygen saturation), radiographs (bitewings and anterior periapicals), oral cancer screening, dental and periodontal charting, plaque index (PI) and mean attachment loss (MAL). Inclusion criteria specified:

- Aged 20 years or older, willingness to voluntarily participate and ability to understand American English
- At least 6 natural teeth
- Chronic periodontitis, as manifested by ≥1.5 mm MAL

Exclusion criteria specified:

- Significant oral infection (e.g., rampant caries or abscesses)
- Antibiotic usage in the preceding 3 months
- Dental treatment in the preceding 6 months
- Institutionalized individuals (e.g., hospitalized, nursing home, assisted living or home bound)
- Pregnancy
- Current cancer or cancer treatment

- Conditions requiring antibiotic prophylaxis prior to dental treatment

Periodontal Parameters

The PI was assessed utilizing Silness et al's criteria.[37] Comprehensive periodontal examination included probe depths and recession using a UNC–12 periodontal probe (Hu–Friedy®, Chicago, IL) at 6 sites on each tooth (partially–erupted teeth excluded), furcation and mucogingival involvement, mobility and bleeding on probing (allowing for a 10 second delay). MAL was calculated by summing all CAL measurements (probe depth plus recession) and dividing by the number of sites recorded.[6,36] PI and MAL scores were not needed for hypothesis testing of quality of life or illness outcomes; they were used to determine eligibility and analyzed as possible co-variates. Intrarater reliability for the principle investigator/clinician was established for the PI (r=0.95) and MAL (r=1.0) utilizing 7 patients presenting with CAL. Measurements were recorded 1 week apart.

Questionnaires

All subjects completed a demographic and oral habits questionnaire at baseline. Two dependent variables were measured using survey instruments as pre–test at baseline and post–test 4 weeks after treatment in the experimental groups. The control group was administered the same pre–test questionnaires at the oral examination appointment and 6 weeks following no treatment to compensate for the 1 to 2 weeks between treatment sessions of experimental groups.

The primary outcome measure, quality of life, was measured using the SGRQ–A (American English modified version of the SGRQ), a questionnaire developed to correlate with medical measurements of chronic airflow limitation to determine if patients perceive improvements or deterioration in status. The SGRQ–A U.S. English version was obtained and used with permission from P. W. Jones, PhD, FRCP, Professor of Respiratory Medicine, St. George's Medical School, University of London. It is an established valid and reliable tool designed to measure impaired health and quality of life in chronic airway disease.[37–44] The SGRQ–A includes 76 weighted items scored 0 to 100 with 3 subscales: symptoms of respiratory problems (frequency and severity of cough, sputum, wheeze), daily activities (limited by breathlessness or troubled breathing) and impacts (influence of breathing problems on social or psychological functioning). A decrease of 4 units or greater in the SGRQ–A total score indicates a clinically significant improvement in HRQL.[39] A change of 4 units (or points) in the mean total score of the

SGRQ–A indicates a clinically significant change in disease status should be observed. This guideline is only applicable to the total score, not the individual subscales. An additional question at the beginning of the SGRQ–A (scored separately and not considered part of the SGRQ–A) ranks self–assessment of overall health status on a 5 point Likert scale from very poor to very good.

A study published in 2011 utilized SGRQ to assess and correlate quality of life in COPD patients with periodontal parameters.[25] Findings indicated number of missing teeth and PI were significantly associated to the scores of quality of life, but periodontal treatment was not provided. To the authors' knowledge, this is the first study to use of the SGRQ–A as an instrument to measure quality of life in relationship to dental treatment.

The second dependent variable (self–reported incidents of illness) was measured by the Illness Questionnaire, developed by the principal investigator. The Illness Questionnaire had 7 yes/no response questions regarding illness in the 4 immediately preceding weeks (respiratory or other), doctor visits, antibiotic usage, usage of respiratory medication and past dental experiences. Face validity was determined by a panel of 3 physicians with expertise in research methods and treatment of COPD patients.

Randomization and Blinding in Research Design

Eligible subjects were randomly assigned by a research assistant to 1 of 3 groups (ultrasonic, hand instruments or control) using a table of random numbers from a random number generating website (Research Randomizer®, Social Psychology Network) until each group had 10 subjects. When a group reached 10 participants, that group was skipped on the random number table until another group was selected. The principal investigator, as treatment provider, could not be blinded to group allocation. However, to ensure the treatment provider was blinded to outcome measures (i.e., answers to questionnaires) a research assistant assigned each participant a confidential code for the questionnaires and administered in a private location.

Treatment Protocol

Subjects in the treatment groups were scheduled for 2 independent periodontal debridement sessions in which half–mouth was treated at each appointment. Local anesthetic was used as needed for pain control and recorded. Both treatment appointments were completed for each subject within a 1 to 2 week time period. Length of appointment was determined by completion of instrumentation until all clinically–detectable deposits in the designated half mouth were removed and varied depending on number of teeth, pocketing and amount of deposits. Treatment for the ultrasonic instrumentation group was performed with a magnetostrictive ultrasonic unit (Cavitron® Jet Plus™, Dentsply International, York, PA) using standard thin tips (30K™ Slim Line Inserts, Dentsply International, York, PA). Treatment for the hand instrumentation group was performed with curettes (Gracey 1/2, 11/14 and 12/13 curets, Hu–Friedy®, Chicago, IL).

To decrease exposure to other aerosols, treatment was provided on a day when the clinic was not being used for other patient care, and there were 30 minutes between treatment sessions. Infection control procedures recommended by the CDC were followed.[31] Water, ventilation and sterilization systems at the clinic met standards recommended by the CDC. The ultrasonic was connected to a closed water system with distilled water treated with waterline maintenance tablets (BluTab™, ConFirm Monitoring Systems, Inc., Englewood, CO). Conventional dental suction was used for evacuation. All subjects pre–rinsed for 30 seconds with 15 ml of 0.12% chlorhexidine gluconate (Peridex®, 3M ESPE, St. Paul, MN) prior to treatment.

Data Management and Statistical Analyses

A power analysis was undertaken to determine sample sizes needed to detect differences between groups based on the SGRQ–A data using the statistical software PASS.[45] A power of 80% was used to detect a large effect size (Cohen's d=0.80) as defined by Cohen.[46] A large effect size was chosen due to anticipated subject recruitment challenges, due to exclusion criteria precluding participation by individuals who were edentulous, taking antibiotics or requiring antibiotic prophylaxis for periodontal treatment.

Data were entered into spreadsheets formatted for SGRQ–A or a statistical software package (SPSS, Version 17.0), proofed for data–entry errors and analyzed in consultation with a statistician. Descriptive statistics were calculated for demographic data. Percentages and frequencies were calculated for categorical data, and means and standard deviations were calculated for continuous data. Statistical tests appropriate to the measurement level of the data were performed to assess additional hypothesized relationships. In order to compare the 3 groups on continuous variables, repeated measures of ANOVA were performed. When statistical significance was detected between groups, post hoc tests (Tukey HSD) were run. To assess the relation-

ship between group and categorical variables, chi–square (x^2) tests of independence were performed. Due to the small sample size the chi–square test was not valid.

The assumptions of normality and homoscedasticity were tested (Kolmogorov–Smirnov test, Levene's test). Nonparametric tests (Wilcoxon Signed Ranks test) were used as appropriate when violations of the parametric assumptions were found. Repeated measures of ANOVA were used for the SGRQ–A total and subscale data. For each of the scale measurements means ± standard deviations were reported. Cross tabulation was used for Illness Questionnaire, demographic and oral habits data and reported as frequencies or percentages.

Results

Thirty subjects were enrolled in the study; 20 received periodontal debridement with ultrasonic instrumentation (n=10) or hand instrumentation (n=10), and the control group (n=10) had no treatment during the study (treatment was offered following study completion). A total of 462 patients with COPD were informed of the study by their medical care provider via mail (n=246) in one practice or telephone (n=216) in the remaining offices. Subject recruitment presented difficulty, as many potential subjects with COPD did not respond to the letter from their provider informing them of the study (n=235). Others did not meet inclusion criteria for the study or were not interested (n=215). Thirty subjects were recruited: 11 by mail, 7 by phone and 12 from fliers.

Subject characteristics are depicted in Table I. Most subject characteristics were ordinal data, with aggregate results reported as frequencies and/ or percentages (n/%). There were no significant differences between groups with regards to age, education, race, smoking status, steroid use, oral habits or PI. Age, PI and MAL data met tests of normality (Kolmogorov–Smirnov test), therefore, ANOVAs were calculated. Means and standard deviations were reported.

Mean age of all subjects was 64 years with no differences between groups (p=0.257). The sample had unequal distribution of sex in the 3 groups, however, sample size was too small to determine if differences were statistically significant. The majority of the sample consisted of current and former smokers (26/30, 86.7%). Extent of plaque biofilm, as measured by the PI, did not differ significantly between groups (total mean PI 1.9±0.49, p=0.672). The mean MAL was 3.9 mm±0.95. A significant difference between groups was found in

MAL (p=0.001). Post hoc Tukey HSD test found the ultrasonic group had significantly more MAL than the hand instrument group (4.63±0.88, 3.20±0.45, respectively). However, the control group MAL (3.86±0.88) did not differ significantly from either the ultrasonic or hand instrument groups. There were no notable differences between groups with regards to oral habits (e.g., type and frequency of toothbrush, toothpaste, interdental aid and antimicrobial or fluoride mouth rinse).

Local anesthesia was used for 4 ultrasonic and 3 hand instrument subjects. Total instrumentation time varied between 40 and 215 minutes (101±50.65 min) but did not vary significantly between the 2 treatment groups as determined by the Mann–Whitney test (p=0.123). This nonparametric test was used because the data violated normality based on one outlier in the ultrasonic group (e.g., 215 minutes) as determined by the standardized residual for total treatment time.

SGRQ–A total scores, overall self–assessment of health scores and Illness Questionnaire responses showed no significant differences between groups with no significant improvements from pre– to post–test for all groups. All SGRQ–A statistics met the assumption of normality (Kolmogorov–Smirnov test). Therefore, ANOVA repeated measures were used to analyze data. Mean scores are displayed in Figure 2. There were no differences between groups on total SGRQ–A scores at pre–test (p=0.422). The total SGRQ–A scores decreased (i.e., improved quality of life) slightly for all 3 groups, although not significantly (p=0.138) and between group interactions (p=0.794) were not observed. There were no main effects of group (p=0.333). With regards to SGRQ–A subscales (Table II), no significant differences were detected between groups for symptoms (p=0.158), activities (p=0.815) or impacts (p=0.286), and no group interactions were observed. The symptoms and impacts scores showed no significant difference from pre– to post–test for all groups combined (p=0.707 and p=0.703, respectively). The activities score decreased significantly from pre– to post–test (improved activities) for all 3 groups combined (p=0.023). However, no interactions between the groups for activities were detected (p=0.702).

Overall current health, a secondary outcome measure not considered part of the SGRQ–A, was measured by a single question at the beginning of the SGRQ–A (5 point Likert scale ranked very poor to very good). Pre– and post–test results were compared separately for each group (Wilcoxon Signed Ranks test). All groups rated their health as slightly improved following treatment/no

Table I: Subject Characteristics

Variables	Total (n=30)	UI* (n=10)	HI** (n=10)	Control (n=10)	p-value
Age (years; mean ± SD)	64±7.90	62±7.76	68±7.20	62±8.33	0.257
Gender (male/female; n)	20/10	9/1	5/5	6/4	
Race (n)					
Non–Hispanic White	25	7	8	10	––
Non–Hispanic Black	1	0	1	0	––
Other	4	3	1	0	––
Education (n)					
Less than high school	1	1	0	0	––
High school	11	3	6	2	––
Some college	9	4	1	4	––
College degree	9	2	3	4	––
PI*** (mean ± SD)	1.90±0.49	1.93±0.45	1.78±0.40	1.96±0.64	0.672
MAL# (mean ± SD)	3.90±0.95	4.63±0.88	3.20±0.45	3.86±0.88	0.001
Smoking status (n)					
Never smoked	4	0	1	3	––
Former smoker	15	6	5	4	––
Current smoker	11	4	4	3	––
Current steroid use (n=29) (yes; n)	3/29##	2/10	1/10	0/9	0.360
Treatment groups only	n=20	n=10	n=10	––	––
Instrumentation time (n=20; mean ± SD)	100.85±50.65	87.20±51.47	114.50±48.50	––	0.496
Use of local anesthetic (yes; n)	7/20	4/10	3/10	––	0.639

*UI= ultrasonic instrumentation
**HI= hand instrumentation
***PI= plaque index
#MAL= mean attachment loss
##One person in the control group did not answer the question about current steroid use

treatment, however, changes were not statistically significant (Table III). The mean self–assessment score in the hand instrumentation group was 3.9 at pre–test and 4.0 at post–test, with no significant difference (p=0.564). For the control group, mean self–assessment scores were 3.3 at pre–test and 3.6 at post–test, with no significant difference (p=0.317). The mean pre–test self–assessment score for the ultrasonic instrumentation group was 3.1 and 3.6 at post–test, approaching statistical significance (p=0.059).

Cross–tabulation showed no difference in yes responses related to self–reported illness (Illness Questionnaire) before and after treatment/no treatment (Table IV). Results were reported as yes responses indicating some degree of self–reported illness. Items assessing respiratory problems, other sickness, doctor visits, antibiotic usage and additional respiratory medications 4 weeks prior to pre– or post–questionnaires were used to determine degree of self–reported illness. The hand instrumentation group (n=10) had 6 yes responses at pre–test with 3 at post–test. The control group (n=10) had 7 yes responses at pre–test with 6 at post–test. The ultrasonic instrumentation group (n=10) had 14 yes responses at pre–test with 5 at post–test.

At pre–test, the control group had the only subject in the study reporting history of respiratory problems after dental treatment (n=1). At post–test, one subject in the hand instrumentation and control groups reported having avoided dental care due to respiratory disease. No adverse events occurred during the study period.

Table II: SGRQ–A* Total and subscale p–values for 3 effects in the ANOVA**

Source	Total	Symptoms	Activities	Impacts
Group***	0.333	0.158	0.815	0.286
Pre–post#	0.138	0.707	0.023*	0.703
Pre–post Group##	0.794	0.124	0.702	0.926

*SGRQ–A = St. George's Respiratory Questionnaire
**p<0.05 (Repeated measures ANOVA)
***Effect 1: Change in score all groups combined.
#Effect 2: Change in score from pretest to post-test.
##Effect 3: Interactions between groups from pre– to post–test

Table III: Self–assessment of overall current health* (mean±SD)

	Pre–test	95% CI**	Post–test	95% CI	p–value
UI***	3.1±0.74	2.84 to 4.26	3.6±0.52	3.34 to 4.49	0.059
HI#	3.9±0.32	3.71 to 4.49	4.0±0.47	3.69 to 4.89	0.564
Control	3.3±1.23	2.78 to 5.35	3.6±1.01	3.08 to 5.38	0.317

*p≤0.05 for within group comparison (Wilcoxon signed–rank test)
**CI=confidence interval
***UI=ultrasonic instrumentation
#HI=hand instrumentation

Discussion

Few studies have evaluated quality of life following periodontal therapy utilizing otherwise systemically healthy individuals,[47-49] whereas this study was the first to evaluate quality of life changes in patients with periodontitis and chronic respiratory disease. Considering the small sample size, variability in responses and careful interpretation of the findings, a few important conclusions can be drawn.

Subjects had moderate to advanced periodontitis, which is consistent with findings from larger scale studies involving patients with COPD.[4,6,9,11] Age, smoking status, PI and MAL measurements agreed with previous findings of patients with COPD.[4]

In this study, quality of life and self–reported illness were measured by 2 separate survey instruments (SGRQ–A and Illness Questionnaire, respectively). Adverse events were monitored, though none occurred. The SGRQ–A is a standardized measure to quantify the impact chronic air flow limitation has on health, well–being and daily activities, and potentially show changes in disease activity.[37] Some authors of periodontal and dental hygiene texts contraindicate use of ultrasonic instrumentation in patients with respiratory disease.[32-34] The underlying assumption has been aerosols contribute to post–treatment complications. This study evaluated quality of life and illness following periodontal instrumentation with ultrasonic and hand instrumentation in ambulatory patients with COPD and chronic periodontitis and found no indication of such problems. Improvement in self–assessment of their overall health by subjects in the ultrasonic instrumentation group approached significance. Although several of these subjects reported illness and/or doctor visits prior to treatment, very few reported such experiences post–treatment. The same pattern was seen in the hand instrumentation group, although reports of illness and doctor visits were fewer at both pre– and post–test. The control group indicated fewer doctor visits at the post–test but showed no improvement in reported illness, respiratory or other, at the post–test. Based on these results, albeit a small sample, it appears the contraindication for ultrasonic instrumentation may be unnecessary in patients who are not infirm.

Age, sex, degree of airflow limitation and differences in interpretation of quality of life questions all affect the SGRQ–A score, producing a high degree of variability in mean scores with large standard deviations.[38,39,41,42] Jones interpreted thresholds for clinical significance of SGRQ–A in patients with COPD.[42] He reported that patients differ in their perception of the importance of how chronic lung disease affects their daily living. This variability would influence findings in this study. The small sample size and high degree of variation in mean SGRQ–A total scores and subscales made it difficult to detect any potential differences or interactions between mean scores of the 3 groups. SGRQ–A questionnaires are population based, so inferences from individual scores should not be made.[42]

A significant improvement in all subjects' ratings of their activities pre– to post–test indicates these patients had less trouble with daily events (e.g., those requiring walking or chores) following treatment. This finding most likely is unrelated to the independent variable of periodontal instrumentation because no differences in ratings of activities were found between groups.

The SGRQ–A is well documented as a valid and reliable measure of quality of life and changes following a variety of therapies for patients with COPD.[38-42] It was anticipated SGRQ–A scores would be high at baseline because of the mean age (64±7.9) and COPD diagnosis, as quality of life is affected by age, sex and disease status.[38] Higher scores occur in older subjects and those with COPD. These scores were not signifi-

Table IV: Illness Questionnaire (reported yes answer; n*)

Question	UI** (pre/post)	HI*** (pre/post)	Control (pre/post)	Total (pre/post)
1. Respiratory problems last 4 weeks	4/2	0/0	1/2	5/4
2. Other sickness last 4 weeks	3/0	1/0	2/2	6/2
3. Doctor visit last 4 weeks	5/2	3/2	4/1	12/5
4. Antibiotics last 4 weeks	0/0	0/1	0/1	0/2
5. Additional/extra respiratory medications last 4 weeks	2/1	2/0	0/0	4/1
6. Any past respiratory problems after dental care	0/0	0/0	1/1	1/1
7. Ever avoided dental appointment because of respiratory disease	0/0	0/1	1/1	1/2

*Reported frequencies per group pre/post out of 10)
**UI=ultrasonic instrumentation
***HI=hand instrumentation

cantly higher following treatment in either group of treated subjects.

No significant differences between groups in self–assessment of overall health indicates that the 20 subjects who received treatment continued to perceive their health as fair and did not perceive any significant improvement or deterioration in health status following treatment. In fact, the ultrasonic instrumentation group perceived a nearly significant improvement in health (from fair towards good). It appears that these subjects' quality of life was not impacted by either form of instrumentation. Illness Questionnaire findings indicated fewer subjects in each treatment group experienced self–reported illness, respiratory problems, other sickness, doctor visits or medication usage within 4 weeks following treatment compared to 4 weeks prior to treatment. This same reduction in post–treatment illness, doctor visits and medication use was not observed in the control group.

These findings cannot be generalized to other patients with COPD and periodontitis because a non–probability sample was used. Due to the small sample in this study, additional research is needed with this population to determine if the lack of effect is found consistently.

Because no adverse events occurred during the study and patients did not perceive a decline in quality of life, health status or illness following treatment, issues related to patient safety were not identified in this small–scale clinical trial of patients with COPD.

Conclusion

In this study, periodontal debridement performed using ultrasonic or hand instrumentation had no effect on quality of life and illness in ambulatory COPD patients, thereby dispelling any safety concerns. The small sample size, however, decreased the power to detect within/between group differences. Further research with larger sample sizes is required to assess impacts of nonsurgical periodontal therapy on quality of life and self–reported illness in patients with respiratory disease.

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Research

Magnification Loupes in U.S. Entry–level Dental Hygiene Programs – Occupational Health and Safety

Leslie McHaney Congdon, BSDH, MS; Susan Lynn Tolle, BSDH, MS; Michele Darby, BSDH, MS

Introduction

The high incidence of musculoskeletal injuries in dental hygienists is a well documented occupational concern.[1-6] To address this concern, the American Dental Hygienists' Association's (ADHA) National Dental Hygiene Research Agenda addresses occupational health and safety with emphasis on the impact of exposure to environmental stressors on the health of users and methods to decrease errors. If learned and used, one technology that may reduce environmental stressors, improve occupational health of dental hygienists, enhance treatment and improve ergonomics during patient care is magnification loupes.[7,8] Designed fundamentally to enhance the visual acuity of practitioners, magnification is promulgated to promote good posture, essentially assisting practitioners in staying in a neutral body position while providing care, resulting in reduced musculoskeletal stress.[9-11] An ergonomically correct neutral body position includes a neutral position for the neck, back, shoulder, upper arm, forearm and hands, which may be achieved when properly fitted loupes are worn during clinical practice.[12,13]

Inherent in understanding the use of magnification loupes in medicine and dentistry is the premise that increased image size will positively impact treatment.[9,10] In dental hygiene, better visual acuity through magnification may facilitate improved assessment of the hard and soft tissues of the head and neck, resulting in improved diagnosis and

Abstract

Purpose: The purpose of this study was to determine policies and practices regarding magnification loupes among faculty and students in accredited dental hygiene programs as measured by a 31 item, self–designed questionnaire. In addition, the study compared policies among dental hygiene programs in 2 year versus 4 year programs in terms of requirements for the use of magnification loupes.

Methods: After institutional review board approval, a 31 item self–designed questionnaire was emailed via Survey Monkey to 303 entry–level dental hygiene programs. An overall response rate of 75% was obtained. Data were analyzed using descriptive statistics and chi–square test of independence.

Results: Results reveal the vast majority of programs do not require loupes for faculty or students, with only 23% of responding schools requiring students to purchase loupes and 8% requiring faculty to use loupes. More dental hygiene programs require students to wear loupes than require faculty to wear loupes. No statistically significant differences (p–value=0.54) in program policies were found requiring the purchase of magnifying loupes by students, based on 2 year and 4 year dental hygiene educational programs. Odds ratio (1.25) give the odds of students purchasing loupes in a 2 year program as 25% higher than a 4 year program. Almost two thirds of respondents reported loupes instruction as a curriculum component, although most respondents spent 2 or less hours teaching in this area. Most programs (90%) do not plan to require students to purchase loupes in the future, although the majority believes proper use of loupes should be integrated in the curriculum.

Conclusion: Most respondents see advantages to loupes, but clinical policies on loupes do not appear to correlate with beliefs. Educational programs in dental hygiene seem slow to adopt and require the use of loupes. Current clinical polices on loupes should be reviewed to ensure graduates experience the potential ergonomic benefits magnification brings to clinical practice during their education.

Keywords: magnification loupes, dental hygiene students, dental hygiene programs, dental hygiene faculty, dental hygiene programs, survey, dental hygiene curriculum

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate methods to decrease errors, risks and hazards in health care.

treatment.[11–13] Visual evaluation of radiographs, crown margins, existing restorations, periodontal probing readings and clinical attachment level assessments, carious lesions and calculus detection may be improved with increased image size.[11] Better visual acuity through magnification may make subtle tissue changes more discernible and improve instrument sharpening skills. Therefore, use of magnification loupes have the potential to enhance client treatment and therapeutic outcomes, as well as enhance the musculoskeletal health of oral care clinicians. For these reasons, more dentists, dental specialists and dental hygienists are utilizing loupes in private practices and educational settings.[14,15]

The inclusion of magnification in dental hygiene curricula is important since it may enable students to better assess clinical details, as well as assess overall oral health status of patients. In the long term it may better prepare future dental hygienists to meet the increasingly complex oral health needs of the public and influence student and faculty retention via the promotion of musculoskeletal health, quality of work and a productive work life. However, studies in dental and dental hygiene educational programs involving magnification eye wear are limited. Those that are available report postural benefits but few have been able to document improvements in patient care.[16–25]

Maillet et al found significant postural benefits for dental hygiene students if they became more proficient with the use of loupes early in their education, and when they were hand scaling.[17] Branson et al[18] reported a relationship between dental hygienist students' posture and the use of loupes, potentially decreasing musculoskeletal problems with similar findings reported by Sunnell et al[19] in their study of dental hygiene students where participants reported decreased neck, shoulder and back pain with the use of loupes.

Leknius and Geissberger revealed the use of loupes among dental students has been shown to reduce clinical errors by 50%,[24] although another study found no significant differences in the quality of cavity preparations done by dental students using loupes and dental students using safety glasses.[20,21] Meraner and Nase's survey of teaching faculty members at a school of dentistry revealed almost one half of the faculty used loupes.[22] Most respondents indicated loupes significantly benefited occupational health and diagnostic abilities of the dentist and patient care delivered, and almost three fourths indicated that wearing loupes should be mandatory for students in the program. Of the faculty respondents, 61% reported they always

discuss the importance of loupes with students.

Thomas et al explored the opinions of practicing dental hygienists on loupes and found 85% of those surveyed believed loupes were or would be advantageous while in school, but most respondents did not think they should be required.[16] The most highly reported perceived advantages of loupes include ergonomics (91.5%), improved probe readings (78.5%), calculus removal (73.3%), caries detection (64.6%) and quality of care (65.2%). The most highly reported disadvantages included adjustment period (46.2%), vision dependency (31.2%), infection control (27.3%) and limited depth of vision (23.6%).

Research suggests that dental hygiene students may benefit from the early use of loupes prior to developing bad postural habits.[17] Dental hygiene programs must teach the most effective techniques and interventions and model the highest standards of professional practice so that graduates can provide quality care and have successful professional careers. Currently, use of magnification loupes is not curricular content required by accreditation standards, nor is it reflected in nationally accepted dental hygiene curriculum guidelines as a best practice. However, the use of magnification glasses continues to increase in dental practice settings due to potential ergonomic benefits. The literature is void of evidence that demonstrates the degree to which dental hygiene schools have embraced loupes as an essential part of entry–level education and clinical practice. This research helps fill this void and may assist faculty with making valid and reliable decisions regarding the future direction of their program's curriculum loupes policies. Consequently, a nationwide survey was needed to assess the policies and practices in the U.S. entry–level dental hygiene programs to determine whether loupes were utilized in the educational environment.

The purpose of this study was to determine the policies and practices regarding magnification loupes among faculty and students in entry–level dental hygiene programs accredited by the Commission on Dental Accreditation of the American Dental Association, as measured by a self–designed questionnaire. In addition, the study compared policies among dental hygiene programs in 2 years versus 4 years programs in terms of requirements for the use of magnification loupes.

Methods and Materials

A 31 item self–designed questionnaire was developed to determine polices concerning use of

magnifying loupes by students and faculty in all accredited U.S. entry–level dental hygiene programs (n=303). The survey consisted of 12 yes/no questions, 6 multiple choice questions, 8 questions that were open–ended response count, 4 Likert–scale questions and 1 comment section to allow for elaboration. Several questions with specific answers also allowed for explanation. The first section requested demographic information, such as respondents' title and affiliation. The next segment solicited programs' current loupes policy for students, the estimated number of students that purchased loupes, when students should begin to wear loupes and identified all items they believed to be advantages/disadvantages of loupes. The third portion pertained to faculty policies on loupes. Finally, participants gave feedback regarding ergonomics of loupes inclusion within curriculum.

Following approval of the university institutional review board, the survey was pilot tested on 10 dental hygiene faculty. Comments and suggestions were incorporated into the final survey instrument to improve content validity and clarity. A current master list of accredited U.S. entry–level dental hygiene programs was provided by the ADHA. A cover letter and the self–designed questionnaire Magnifying Loupes in U.S. Entry Level Dental Hygiene Programs were distributed to the program director of each college/university, using a commercial web–based software company (Survey Monkey). The cover letter explained the research was supported by a grant from the ADHA Institute for Oral Health, explained the purpose of the study as well as the approximate time it would take to complete (20 to 30 minutes) and requested the recipient respond to the questionnaire or forward the survey to the most qualified faculty member for completion. The cover letter also explained results would be reported in aggregate form only and individual responses would be anonymous. One week after the initial electronic mailing, a second distribution of surveys was launched to non–respondents. A third distribution of surveys was launched to non–respondents 2 weeks later due to the fluctuating

Table I: Total percentage of respondents from all educational settings
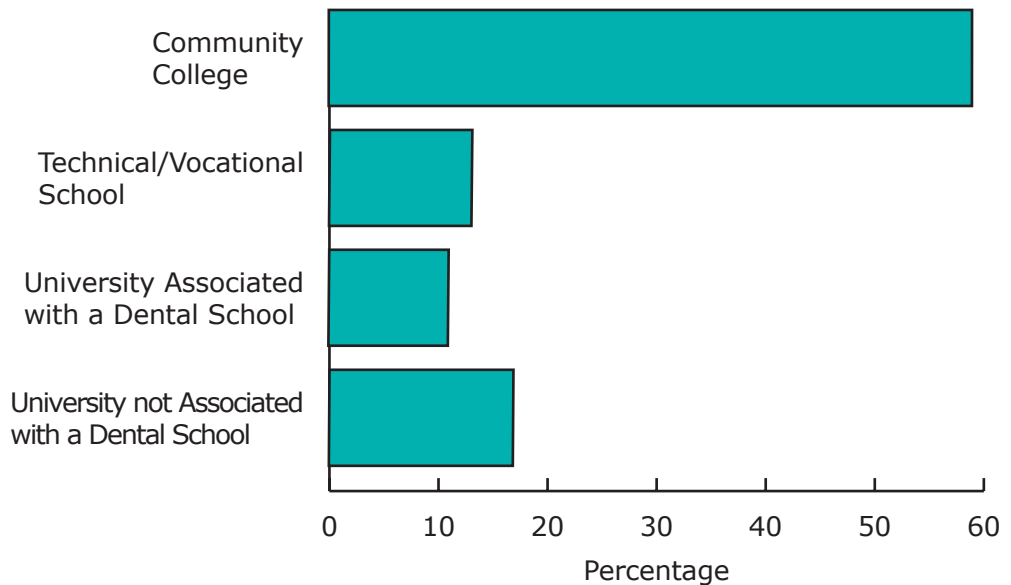
college winter breaks. The survey was closed 3 weeks after the third electronic mailing.

Data were collected and tabulated by Survey Monkey, and statistical analysis was performed using JMP version 8.0.2 software. Quantitative analysis of data utilized percentages, frequency distribution and Pearson's Chi–square test. The significance level was set at 0.05.

Results

A total of 303 surveys were electronically mailed (n=251 for 2 year programs, n=52 for 4 year programs). Of those, 236 were returned for an overall response rate of 75% (227). Seventy–three percent of respondents were from 2 year programs and 27.9% were from 4 year programs, with a breakdown by type of program presented in Table I. Most respondents (76.2 %) did not require students to purchase loupes. Of the 23.8% who did require loupes purchase, 21.3% were from community colleges, 17.2% from technical/vocational schools, 21.7% were universities with dental school and 17.9% were universities without dental school (Figure 1). Of the 78% of programs that do not require loupes, 35% reported over half of their second year students voluntarily use loupes and 15% reported their whole second year class voluntarily uses loupes. Results reveal slightly more schools (23.8%) required purchase of loupes than mandate their actual use (20.3%). No statistically significant differences were found (p=0.54) in dental hygiene educational program policies requiring the purchase of magnifying loupes by students, based on 2 and 4 year programs. However, odds

Figure 1: Dental hygiene program policy requiring loupes for students
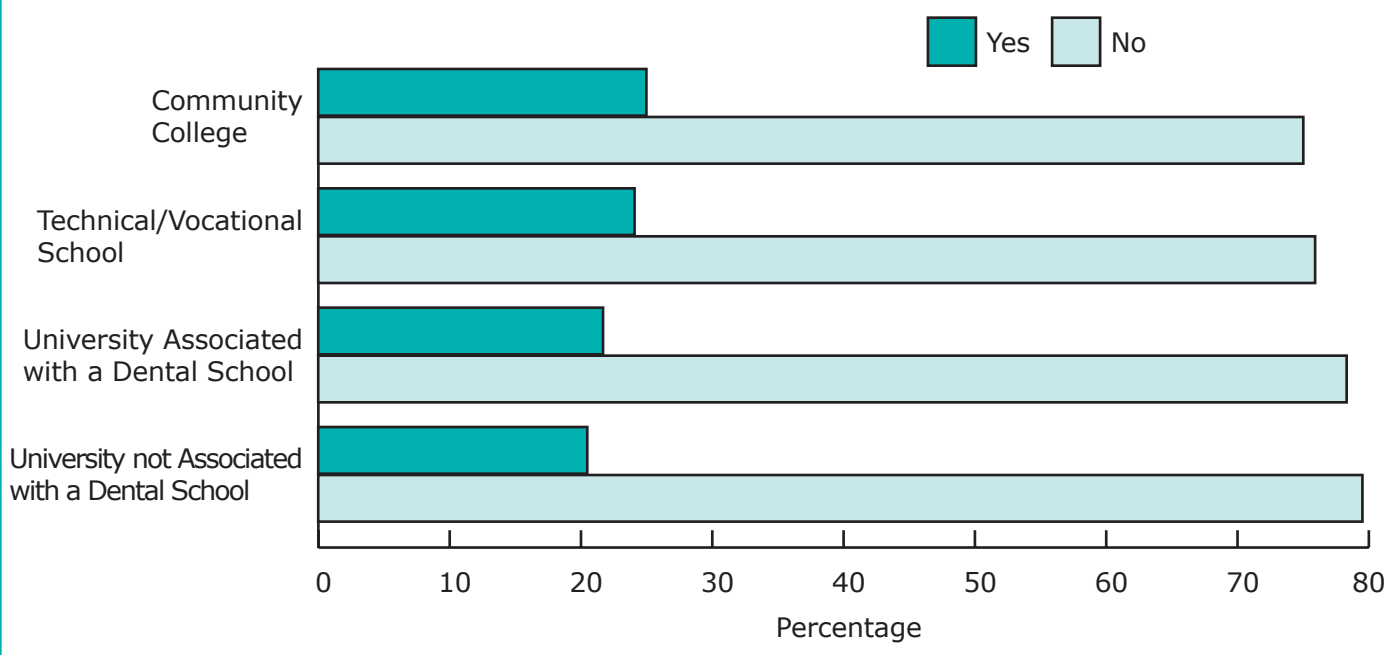
ratio (1.25) give the odds of students purchasing loupes in a 2 year program as 25% higher than a 4 year program.

Almost all participants viewed ergonomics as an advantage of wearing loupes (93%), followed by improved periodontal probe readings (90.3%), caries detection (69.6%), restorative evaluation (69.6%), decreased musculoskeletal pain (68.3%), improved patient care (61.2%), radiographic interpretation (59.5%) and calculus detection. Disadvantages identified included: expense (86.7%), adjustment time (37.2%), limited depth of field (26.1%), infection control (25.7%), uncomfortable (17.3%), dependency (16.8%) and headache (14.6%). Comments from participants are found in Table II.

Just over one third of respondents indicated the ideal time students should begin to wear loupes was during pre–clinical education, with 1 of 4 respondents indicating the second year was the best time to begin to wear loupes. Combining pre–clinical and first year results reveals 63.4% consider students' first year ideal. Chi square results reveal a statistically significant difference between schools that require loupes and those that do not when comparing when students should first begin to wear them (p=<0.0001). Of the programs that required students to purchase loupes, the majority (64.8 %) indicated pre–clinic is when students should begin wearing loupes, with just under 10% indicating the senior year (Figure 2).

More than half of faculty respondents indicated

Table II: General Open Ended Comments from participants on Loupes usage

- Cost prohibit mandating
- Difficulty attaining consensus among faculty
- Do not require loupes but we recommend them to students
- Too much additional information for students
- Alter natural vision/ dependency
- Inhibit development of tactile sensitivity
- Which brand/company to recommend
- Arbitrator between student and company
- Implies dental hygienist need loupes to be efficient
- Some students cannot adapt
- Loupes too heavy
- Not proven to enhance treatment

they always or almost always used loupes in clinic, although an overwhelming majority of respondents (90%) indicated they did not have program polices requiring faculty to purchase and use loupes in the clinical setting. However, of the programs that required students to purchase loupes, results suggest more lenient polices for faculty, as 66% of the programs that require student to purchase loupes do not require faculty to do so. No statistically significant difference (p–value=0.27) were found between 2 and 4 year dental hygiene educational programs for faculty use of magnifying loupes in the clinical setting.

Very few institutions paid for faculty loupes, with only 10% paying for full–time faculty and 3.9% for part time faculty's loupes. About 77% of par-

ticipants indicated loupes were integral in private practice, while 23.2% did not see loupes as integral to practice in the private sector. Most programs (90%) do not plan to require students to purchase loupes in the near future, although the majority (73%) believe proper use of loupes are integral to the curriculum.

Most participants (62.5%) indicated they had ergonomic instruction on magnification loupes as a component in the curriculum. Of those respondents that cover the topic, almost 70% spent 2 or less hours on loupes and many relied solely on the loupes' sales representative for all loupes instruction.

With 76.8 % of respondents indicating loupes are integral to private practice, only 62% identified ergonomics instruction on magnification loupes as a curriculum component. Of those respondents that cover the topic, almost 70% spend 2 hours or less on loupes training.

Discussion

This study examined polices on magnification loupes in dental hygiene programs. Results suggest schools of dental hygiene have been slow to adopt the use of loupes in their curricula. Most schools do not require students or faculty to purchase loupes. The ergonomic benefits of loupes are well supported in the literature and concern is generated when so few schools are requiring students to wear loupes.[8–15] While research has documented the ergonomic benefits of loupes, few studies have documented improvements in oral diagnosis and treatment by the loupes wearer.[8–12] Perhaps some schools may not have policies that require loupes due to the lack of scientific data available that demonstrate improvements in patient care as a result of magnification. Sunnell and Rucker also argue that surgical magnification may not be as important for dental hygienists due to their periodontal focus that relies on subgingival instrumentation and tactile sensitivity more than visual acuity.[22] Although this reasoning ignores the issue of posture and musculoskeletal malady, it leads to another possible explanation for this study's results, where over three quarters of the responding dental hygiene programs do not require loupes.

Figure 2: Dental hygiene program perspectives on when students should begin to wear loupes
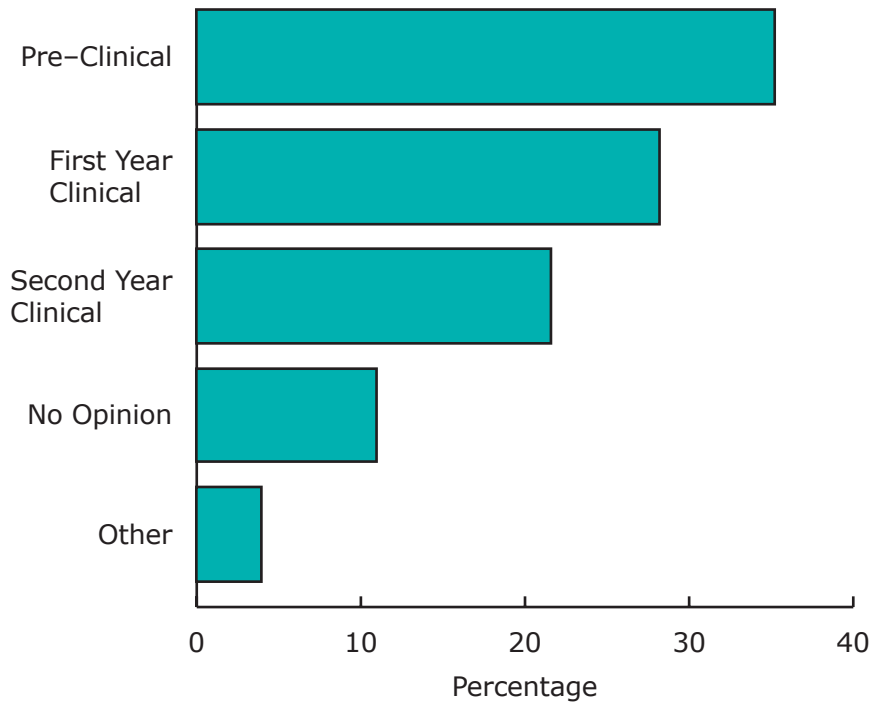
Another plausible explanation for a low number of schools requiring students and faculty to wear loupes is cost. Almost all respondents cited cost as the greatest disadvantage of loupes, which was also reported by Thomas et al as the greatest disadvantage.[16] Ranging in price from $400 to $1,200, the added expense may appear overwhelming in light of numerous instruments, supplies and lab fees students must incur when enrolling in a dental hygiene program. The benefits have the potential to outweigh the cost, when years of improved ergonomics may result in fostering a longer and more productive career in clinical practice. Several respondents' comments echoed explanations as they cited indecision on which company to use, arbitration between students and manufacturer, difficulty attaining consensus among faculty and not mandating use of loupes in the clinical setting, claiming treatment benefits are not proven (Table II).

Results from this study suggest dental hygiene programs require loupes for students more often than faculty. This result might be explained by some faculty not viewing themselves as direct care providers and hence the need for magnification eyewear would not be as great as for students. Additionally, some faculty may see their role as less demanding ergonomically since they often spend less time than students actually working in a patients' oral cavity.

Odds ratio reveal a greater probability of 2 year programs requiring students and faculty to purchase loupes than 4 year programs. A possible explanation of the student finding could be the lower cost of instrument kits and supplies in 2 year programs, although this data was not obtained Another cost factor could be related to tuition, as the American Dental Association reports tuition in 2 year schools as substantially less on average than 4 year schools housed in universities and dental schools.[26]

Results varied concerning the best time students should begin to wear loupes. However, the programs that required loupes more frequently indicated pre–clinic as the optimum time to start wearing loupes when compared to all respondents. The varied findings in this study may be due to those programs that require loupes being more familiar with how they can assist students at all levels of clinical learning since they have more experience with them compared to other schools. As suggested by Maillet et al, an early start with loupes may reinforce neutral positioning and enhance posture early in the educational process before improper habits are learned.[17] Students can become comfortable with loupes during instrumentation on typodonts prior to treating patients. Some schools may also mandate an early integration of loupes in pre–clinic since they find it beneficial to have students incur this expense at the same time as other instrument, lab fees and supply expenses covered by outside sources, such as student loans or grants. Roughly 1 in 4 respondents indicated the second year as the optimum time to start wearing loupes. Perhaps faculty believe learning pre–clinical skills such as indirect vision, tactile sensitivity and other instrumentation basics is best learned first with unmagnified vision. The lack of supportive research on clinical benefits may be another plausible explanation for faculty not requiring use of loupes in pre–clinic courses.

One half of respondents report wearing loupes while teaching in the clinic, which is similar to findings from a survey of dental school faculty.[19] However, only 10% of respondents had program policies that required faculty to wear loupes. Apparently many faculty believe the wearing of loupes have advantages but not enough to mandate their use. Faculty need to be role models for students. If program policies do not reflect that loupes are important for faculty, many students may not view loupes as advantageous enough to incur the expense unless mandated. With expenses continuing to rise and budgets continuing to decrease in many institutions, it is not surprising that few schools paid the cost of loupes for faculty. If the expense was covered by the institution, polices would predictably change since respondents see many advantages to wearing loupes.

Of the programs currently not requiring loupes, few plan to change their policy in the future. This is unfortunate since musculoskeletal health of students and faculty could be affected.

The majority of responding faculty reported they include loupes ergonomics instruction as part of the curriculum. However, the one third of respondents that do not cover this topic in their curriculum may be doing a disservice to their students. These schools may wish to evaluate their curriculum to ensure coverage of this important topic so tomorrows practitioners have a full realm of options for ergonomically sound dental hygiene practices. Beach et al reported the majority of programs did not offer ergonomic education beyond patient/operator positioning due to lack of room in curriculum.[21] This could be a possible reason for the low number of hours found in this study that was devoted to loupes education.

Since proper fit is integral to the successful use of loupes, students need to be measured in the clinic with a patient in the chair to attain the proper patient–clinician distance, as well as the angle of the telescopes. Therefore, curriculum should have both a clinical and didactic component. Manufactures of purchased loupes must be obliged to provide initial and follow–up instruction, as well as clinical support as needed to obtain optimum outcomes since proper loupes fitting is outside of the role of most faculty.

In summary, clinicians often slouch or bend to enhance their visual perspective and risk serious cumulative injury.[1-6] Loupes can aid in reinforcing proper ergonomics, musculoskeletal health and greater visual acuity with less eyestrain. This could result in prolonged physical health, dental hygiene careers and greater visual acuity resulting in enhanced patient management.

There are limitations to the current study. Results can only be generalized to the responding population and may not represent all dental hygiene programs. This present study did not elucidate the student perspective which could impact results. The questionnaire did not clearly define pre–clinic from first year clinic, which may have confused respondents.

Future studies need to be conducted to determine if visual magnification improves student performance, the most optimal time loupes should be

introduced into curriculum and student opinions of the value of loupes in clinical practice. Research is also needed to investigate why faculty recognize the importance of enhanced vision with loupes but are resistant to requiring the wearing of loupes in the educational setting.

Conclusion

Most responding dental hygiene programs do not require students or faculty to purchase or use loupes. The majority of respondents believe students should begin to wear loupes in their first year. Most respondents see advantages to loupes, but clinical policies on loupes do not appear to correlate with beliefs. Educational programs in dental hygiene seem slow to adopt and require the use of loupes. Current clinical policies on loupes should be reviewed to ensure graduates experience the potential ergonomic benefits magnification brings to clinical practice during their education.

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Dental Team Experience (DTE): A Five Year Experience

Rebecca L. Stolberg, RDH, MS; Lisa A. Bilich, RDH, MS;
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Introduction

Since the beginning of dental hygiene education, dentists, dental hygienists and dental assistants have been trained in isolation of one another. If the dental hygiene student is enrolled in a dental hygiene program associated with a dental school, the student may be able to provide care in a team environment with a dental student. However, the majority of dental hygiene and dental assisting programs are located in community and technical colleges, making it difficult to interact as a team prior to graduation.

Examples exist in the literature, primarily in European countries, of interprofessional training of nursing, medical, physical therapy and occupational therapy students.[1-5] Communication and respect among medical and nursing students improved in interprofessional training experiences in the U.K.[1-3] In 2009, 616 medical, nursing, physical and occupational therapy students participated in a 2 week clinical teaching experience in Sweden. As a result of their experiences, the students reported improved knowledge of other professions' skills, communication and teamwork philosophy.[4] In another study, students of medicine, nursing, occupational and physical therapy departments were trained together in a clinical setting in Denmark for 3 months. Results showed that patient outcomes improved with fewer complications found in those patients treated by an interprofessional team.[5]

The concept of educating dental and dental hygiene students together has been done in some other countries. The University of Groningen, Netherlands, educated dentists and dental hygienists together.[6] Each week students in both groups focused on a specific case study. By the last year of study, dental hygiene students man-

Abstract

Purpose: Several European countries have interprofessional training for health care professional students, including dental and dental hygiene students. However, very little training exists in the U.S. where dentists and dental hygienists are educated together. The 4th World Congress of Preventive Dentistry and the American Dental Education Association have stated that teamwork must be taught in the dental professions. In 2005, Eastern Washington University began an interdisciplinary team experience in which graduating dental hygiene, dental assisting and dental students worked in an interdisciplinary team providing care to the underserved. A new team was formed each year for the next 5 years. This paper addresses the establishment and outcomes of this interdisciplinary experience.

Keywords: Dental Team, Interdisciplinary, Interprofessional Education

This study supports the NDHRA priority area, **Health Services Research:** Determine the extent to which dental hygienists' working in collaborative practice settings with other health professionals or organizations improves the cost–effectiveness and quality of health care outcomes.

aged a student team practice along with dental and dental assisting students. The Dalhousie University School of Health Services Administration, Nova Scotia, Canada, constructed interprofessional learning modules for students from dentistry, dental hygiene, nursing, medicine, social work, occupational therapy, pharmacy, audiology, health education and kinesiology.[7] The curriculum was formed on the premise that, if you educate professionals to work together more effectively, their treatment for the clients and patients will be enhanced by such cooperation. The modules were well received by students. Barriers included university administrative support and the need for faculty support and rewards for working towards interprofessional education. There was evidence in the literature illustrating dental hygiene and dental school program attempts to work together on external clinical rotations. The University of Alberta Dental School has dental and dental hygiene students serve a minimum of 2 weeks at community clinics together.[8] Goals of this project are to have students become more confident about

their own abilities and to foster professional and interprofessional relationships between different dental practitioners.

Minimal evidence exists as to outcomes associated with similar attempts in the U.S., especially in dentistry. Evans et al stated the need for further attempts at interprofessional dental education in the U.S. because teamwork is essential for the provision of contemporary high quality oral health care. Formal curricula and opportunities are needed as only anecdotal evidence currently exists.[9] The University of Maryland began having dental and dental hygiene students partner to provide comprehensive care to patients in 1981.[10] The reason cited was to simulate post graduation practice of dentistry. Interdisciplinary training among dentists and dental hygienists was also seen to be essential by Old Dominion University, and in 1986 they devised a curriculum that would facilitate teaching collaboration among these 2 professions.[11] When the dentist and dental hygienist develop a collaborative working relationship, the productivity, individual work satisfaction and continuity of care will be strengthened. This practice model stressed mutual respect, economic realities and collegiality. They suggested role playing to be a vital part of this model.

In 2002 the University of Southern California School of Dentistry launched an interdisciplinary project including dental and dental hygiene students, medical and nursing students and social work students.[12] The project was conducted externally in elementary schools and mobile clinics. While project outcomes were positive, the sustainability was questioned due to scheduling difficulties and uncommitted faculty. Many community service events include dental and dental hygiene students working together, such as Give Kids a Smile Days, school based projects and mobile health clinics.[13–16]

The 2006 American Dental Education Association Commission on Change and Innovation in Dental Education stated the vision of the health care team is clouded by the reality that students in isolated health professions have little interaction with each other.[17] Dental students typically experience the 4 years of dental school in complete isolation from other students in the allied health professions. R.E. Nowjacks–Raymer noted at the 4th World Congress of Preventive Dentistry that teamwork must be taught.[18] All health care professionals must be formally taught how to be effective team participants and be given the opportunity to practice the skills involved in teamwork. In order to alleviate lack of respect between disciplines, roles must be respected and each team member utilized to their fullest potential. Effective communications must be established with conflict being resolved.

Methods and Materials

Dental Team Experience

In 2004, Eastern Washington University (EWU) began the development of an interdisciplinary team experience. The purpose of this experience was to provide an opportunity for dental, dental hygiene and dental assisting students to work as a team prior to graduation in hopes that they would be better able to function as licensed dental team care providers. This paper will describe the process of initiating the program, including planning, funding and logistics. In addition, the paper will report outcomes found over a 5 year period.

Discussions with the state's only dental school, the University of Washington School of Dentistry, lead to an agreement to have senior dental students participate. To gain the full complement of a dental team, the local dental assisting program located at Spokane Community College (SCC) was invited to participate. The outcome was a dental team consisting of senior dental hygiene students, senior dental students and dental assisting students in their final quarter of study. This 5 year running project, which began spring 2005, was called the Dental Team Experience (DTE).

Funding

It was necessary to secure funding for a coordinator, dental materials, dental equipment and housing for the dental students. Funding for the coordinator was initially obtained from the EWU president in the amount of $5,000, with the additional salary of $7,000 being secured from the local dental society. The dental hygiene program was looked upon very favorably by the current university president who was very supportive of innovative efforts in education. Many dental faculty were members of the local dental society and they were able to obtain the additional funding needed.

The community college and university clinics lacked dental instruments and supplies to add the teams to their clinics. Thus, donations from dental corporations were sought via an informational letter of request. Some corporations donated money, some instruments and supplies. The remainder of the necessary equipment and supplies was purchased using discretionary funds from EWU and

the community college. The instruments were used only for the 3 week DTE experience, so there is minimal wear and tear on them.

The second and third year, the coordinator and scheduler salaries were supported by Robert Wood Johnson Foundation Community Dental Education Pipeline Program dollars. For years 4 and 5 the university and community college funded necessary salaries and supplies.

Mission and Goals

A mission and 6 goals were developed by the DTE coordinator, dental hygiene program director, dental assisting program director and dental school liaison. The mission was to provide an opportunity for all team members to work together to provide services to the underserved population of Spokane County and to experience the complexities of dental practice. A key portion of the mission was not only to train dental team members together but to assure that the underserved gain access to care. Goals for the DTE were as follows:

1. To increase efficiency of the team
2. To provide an opportunity for all team members to work together
3. To provide services to low income and the underserved population in Spokane County and surrounding areas
4. To provide quality care to patients as evidenced through patient evaluations
5. To appreciate the need for the development of the leadership skills
6. To appreciate the complexities of dental practice

Student Selection

Dental student participants were required to satisfy specific criteria to be selected for participation. The criteria included completion of all restorative dentistry requirements, the Chair of Restorative Dentistry approval and a willingness to relocate to Spokane, Wash for 3 weeks. A total of 3 dental students were selected. Initially there were not as many dental students interested in participating in DTE for the first 2 years because of the commitment required to be in Spokane for 3 weeks. However, after hearing about DTE from dental students who had participated, more excitement and interest was garnered which caused the process to become more competitive.

Selection of dental hygiene student participants was based on satisfying the following requirements: dental hygiene students must have com-

pleted the restorative requirements necessary to take the Western Regional Board Exam, be current on their clinical requirements and complete an application including an essay on how the student felt they could contribute as an effective team member. A total of 5 dental hygiene students were selected each year. Approximately 12 dental hygiene students applied each year.

Dental assisting students were selected based on their ratings of performance after their first of 2 externships, in addition to supportive faculty evaluations and the amount of time they had spent performing chair side assisting. A total of 8 dental assisting students were selected. Because the dental assisting program had 48 students from which to choose from, the dental assisting program director selected who was available to participate in the DTE.

Sites

EWU Department of Dental Hygiene clinics served as one site giving the opportunity for the dental team to see patients in a dental hygiene school environment. Eight chairs were used at EWU with a preceptor dentist.

The second site was a Federally Qualified Health Center (FQHC) safety net clinic that treats low income and the uninsured, and is the location for the HIV clinic for Eastern Washington. Seven chairs were used by the DTE students with 1 lead dental assistant, a dentist preceptor and a registered dental hygienist employed by FQHC to help onsite for the experience. The FQHC handled its own billing and payment procedures.

The third site was the dental assisting clinic at SCC. While at this site the dental team treated mostly community college students. Twelve chairs were used with a volunteer dentist from the community helping with the experience. EWU handled billing and insurance issues for the community college as they were not set up to perform these functions.

Affiliation Agreements

Affiliation agreements needed to be signed among the 3 clinical sites. Adjunct faculty appointments with the dental school were also necessary for dental student supervision.

Orientation

Orientation was seen as a critical piece of the DTE. The goal of this portion of the experience

focused on introducing students and beginning to define their preferred work environment. Morison et al found that, as a result of dental professionals' isolated educational experiences, students have little knowledge of roles of each other in the dental team or how they fit into a team.[19] Obstacles identified from the results of isolated education can be the lack of communication in the team, as well as role identity in the dental practice.

There were several tools introduced during orientation that could be used to deal with the challenges of forming a new team, including conflict management, early team management skills, 360 degree assessment and components of successful team meetings.

Originally, orientation was held two days before clinical practice. Over the first 2 years, the structure changed – orientation was held one day before clinical practice, with team–building exercises held throughout the entire experience. Based on feedback from students, the orientation was organized in a more succinct manner, due to the difficulty for many students to miss educational experiences in their classrooms to come to another site. The use of an online learning management system (LMS) for assignments and initial introductions was seen as a helpful tool.

The DiSC Personal Profile System® (Inscape publishing, Mount Prospect, Ill) was used extensively to help students discover the best way they work with a team. The tool helped to identify their behavioral style and which strengths they can provide to the dental team. The key was having students understand there is no right or wrong answers – it is meant to be a non–judgmental reflection on preferred work style. Conflict is inevitable among a team which can lead to poor quality dentistry, unproductive days and a lack of communication.[20]

The students guide the process and the team formation during orientation to provide optimal care for patients and meet the needs of the team. The group was required to determine the mission and vision of the team during orientation. Considering that dentists, dental hygienists and dental assistants are educated in different environments and may not be aware of the functions and abilities of each, it was an ambitious goal to form a dental team quickly. To facilitate integration, groups were formed to include each team member. Dentist, dental hygienist and dental assistant facilitators for the experience role modeled the optimum team so that participants could observe unity and open communication.

Results

While at the FQHC site, the team provided care to approximately 110 patients totaling $7,500 in dental treatment. While at the EWU site, the team provided care to approximately 75 patients totaling $6,640 worth of dental treatment. While at the community college site, the team provided care to approximately 115 patients totaling $7,675 worth of dental treatment.

Full participation in clinical experiences and assessment of each week was required by all participants. These surveys were a 360 degree assessment of the team for that week. Dental students were asked to assess dental hygiene students' cognitive and professional behavior each week. This allowed the hygiene student time to self–reflect and get feedback on how they were perceived by the team. Skills that were assessed included cultural awareness, treatment planning execution, critical thinking, integrity toward team and problem solving. Dental students were also given feedback on cognitive and team leadership skills by the dental hygiene and dental assisting students. The skills assessed for dental students included treatment planning follow–through, confidence, total patient care, communication, recognizing strengths of each team member, fostering trust and goal setting. All students were asked to evaluate the whole team each week. Each participant was asked to evaluate their communication, trust, support provided to team, conflict resolution skills and organization. The students tracked the evaluations to be able to note progress of the team. An entire program evaluation took place at the end of the 3 week time period.

Team meetings were divided into 2 types – the morning huddle and the end of the week staff meeting. The morning huddle focused on events of the previous day, suggested improvements and role assignments. Dental assisting students worked a variety of roles, ensuring that each had the opportunity to assist both dental and dental hygiene students. Dental hygiene students were either assigned to restorative, dental hygiene therapy or utilized as a roving dental hygienist to help with anesthesia or provide support for a dental or dental assisting student. This individual was also charged with quality assurance of charts at the end of the day. Treatment by dental students was discussed with the dental mentor to ensure was followed. End of week meetings helped with self–efficacy of each team member by reminding them how well they performed.

Patient surveys were conducted annually (Table

Table I: Patient Outcome Survey

Please Rate Us:	Excellent	Very Good	Good	Fair	Poor
1.Courtesy/attitude of receptionists	44	7		1	
2.Courtesy/attitude of faculty	1343	7	1	1	
3.Courtesy/attitude of team	44	6	2	1	
4.Cleanliness of dental clinic	44	8			1
5.Quality of overall care you received	41	8	2	2	
6.How well were your questions answered	39	8	2	1	2
How well did dental team member explain:					
7.Your gum & tooth condition	32	13	2	2	
8.The treatment you needed	34	10	2	2	
9.Your options on where to get treatment done	27	9	1	1	2
10.Your option to refuse treatment	24	8	1	3	2
11.The risks and benefits of treatment/no treatment	24	9	1	2	1
12.The cost of your treatment(s)	628	10		1	3
13.The work which you could have done	27	6	3	2	1

I). Many of the clients needed more treatment than the DTE teams were capable of providing. The project was hesitant to perform even single canal root canals because of the lack of ability to follow–up with the clients. Equipment was a limiting factor for extractions as well as lack of ability to follow–up. Overall, patients were very pleased with the program.

Each dental student had a week of required private practice observation and limited treatment in varying dental offices. Types of offices included oral surgery, pedodontics, general dentistry, periodontology, orthodontics and endodontics. Students reported the least benefit and learning from these experience during the DTE mainly because they wanted to be treating clients.

Discussion

Challenges to the 5 year DTE project were numerous. Students expected to be treated as practitioners and not students. However, the faculty at all involved educational facilities knew they had not yet graduated, nor were licensed. In addition, some of the students failed to keep accurate records. Many were uncomfortable walking into a new clinical environment each week and felt it was too much to learn. Students commented that there was lack of standardized hours at each site, standardized computer patient software and felt there was a lack of calibration among sites. Part of the goal of the program was development of leadership skills for the students, and this was attempted by placing students in different environments so they were forced to rely on team members for success. The clinical sites purposely did not calibrate with one another because they felt it was important for the team to figure out how to cope with a new environment each week. The project team determined this to be an actual positive aspect of the DTE, since inconsistencies are a natural occurrence in practice.

Budget issues were always present. The FQHC lost $15,000 to have the DTE there because of having to dedicate 7 of their chairs. However, the FQHC's clinical director still felt the experience was invaluable and worth this loss. The first year the coordinator didn't have enough time to schedule clients so the EWU staff was overburdened with this job. It became evident that a scheduling person would need to be assigned for future success.

An unintended consequence of the DTE was the mere fact that not all dental hygiene or dental assisting students could participate, which led to hurt feelings from those who were not chosen. In addition, the teams functioned differently each week because one dental student was participating in the private practice rotation any one week and not in the clinical portion of the experience for that week.

In terms of success, procedures were done faster each week as the event progressed. Dental students gained true understanding of capabilities of both dental hygienists and dental assistants. Dental hygienists gained better understanding of how to work with a dentist and dental assistant.

Dental students saw more patients in 3 weeks than they had seen in 2 years of dental school. Each year all students unanimously would recommend others to participate in this experience. Students felt there was a growth potential in this experience that outweighs a full quarter at school. One dental student participant responded:

"This by far has been the highlight of my school career! I learned so much about myself, strengths and weaknesses, what to look for in future employment. It really prepared me and gave me the confidence in myself and my training."

A dental hygiene student stated:

"It definitely helped my time management, communication, teamwork skills an immeasurable amount. I am so happy I had this experience as I am so ready for work."

Another dental hygiene student stated:

"It was amazing learning how the different dental professionals function. It gave me a greater respect for each professional."

The dental students commented on growth in team management skills, dealing with frustrations in the clinical setting and communication with other team members. The dental hygiene students commented on growth in improved anesthesia technique, speed for all procedures, communication with patients and team and adaptability to different sites and different patient types. The dental assisting students commented on growth in faster and more accurate x–rays, health histories and blood pressure reading, better chair side assisting, improved 3–way syringe and suction use and improved communication with the team and patients.

The mission of the DTE was achieved in 2 ways. Dental, dental hygiene and dental assisting students gained respect for each member's capabilities, as well as how to utilize each member better. The Spokane community was served with an average of $21,000 annually of high quality dental treatment provided by the DTE. The faculty, staff and project coordinator found the DTE to be an extremely beneficial interdisciplinary team experience. Each year more of the challenges were transformed into successes. It can be argued whether the participating student or the community were the largest benefactor in that the participant gained so much real life experience, while the community gained necessary dental care that it would not have otherwise been provided.

As the DTE progressed, 4 major recommendations surfaced:

1. The dental assistants appeared to have the largest amount of frustration with working outside their comfort zone – one recommendation would be to start the rotations at the community college
2. Expectations need to be clearly stated to all students in manual/written form – students often behaved as if they were already graduated and licensed since they were no longer at their home site
3. An orientation was needed at each site on the Monday morning of the week the DTE was at that specific site to keep all of the information current and consistent
4. It became important to have the experience earlier in the academic year so the dental students were not away from the dental school for end of year activities

Due to the current economic situation and budget shortfalls, the DTE was placed on hiatus for 2010 and 2011. With budget constraints it became difficult to justify a 3 week experience in which only a few chosen students at all institutions could participate. It will also be valuable to consider a mechanism by which all students could participate in such a rewarding and educational stimulating team experience, thereby eliminating those who feel that they were not part of the chosen group. In the current budgetary situations found across all levels of higher education, investment in creative educational solutions will need to impact all students, not the select few.

Meanwhile, another dental experience has begun at EWU – the Regional Initiatives in Dental Education.[21] This program is an extension of the University of Washington School of Dentistry in which 8 first year dental students accepted to the School of Dentistry participate in coursework in Spokane, along with medical and dental hygiene students. These 8 students then return to their home campus for the second and third years of dental school, followed by a return to Eastern Washington for a portion of their fourth year. While this experience is not exactly the DTE, it does allow for some dental students to interact more regularly with dental hygiene students.

Conclusion

From a dental hygiene education perspective, the outcomes achieved by dental hygiene students who participated in DTE were well above expectations. Unfortunately, dental team members are

often trained in isolation of each other. If dental hygiene students are fortunate to train within a dental school, they may have limited opportunities to interact with dental students, but rarely with dental assisting students. By bringing dental and dental assisting students to the dental hygiene school environment, we were able to provide a team experience for dental hygiene students in which they could grow in clinical skills, improve time management and also gain insight into how to best interact with a dentist. This experience can only help improve the dental hygienists' ability to be an excellent member of the dental team.

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Research

Hygiene Self–Care of Older Adults in West Virginia: Effects of Gender

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Introduction

In 2000, the U.S. spent $56 billion on dental care for diseases which are generally preventable with good oral hygiene self–care. Oral diseases often have systemic ramifications if they are unchecked.[1–3] Older adults have many oral health diseases and conditions, and particular attention for their oral health care is needed.[4] In addition, older adults are the fastest growing segment of the U.S. population, expected to comprise 16.27% of the population by 2020.[5] In general, older adults frequently have oral health problems and elderly residents of rural areas are more likely to have poor oral health and inadequate utilization of dental care.[6] Neglect may lead to carious lesions and periodontal disease, as well as pain, inflammation, tooth loss, oral dysfunction and a diminished quality of life.[5] Residents of the geographic region of Appalachia, and West Virginia in particular, have significant problems with carious lesions and other oral health concerns, and the degree to which they impact older adults are currently under study.[7]

Periodontitis, carious lesions and tooth loss are caused by destructive oral biofilms.[8–15] Over 700 different bacteria may co–exist in a dynamic oral biofilm matrix community.[8] In a healthy situation, the oral biofilm is potentially protective as indigenous or resident flora may inhibit pathogens.[2,15] Changing the biofilm environment to a lower pH (i.e., with an acidic or highly refined carbohydrate diet, certain medications or changes in saliva) encourages growth of destructive acid–tolerating species (such as cariogenic mutans streptococcus and lactobacil-

Abstract

Purpose: This study investigated whether oral hygiene self–care behavior differs between genders in older adults in Appalachia, a geographic area with significant oral health concerns. Identifying the practices of older adults may provide valuable information for designing interventions and improving overall oral health outcomes.

Methods: As part of a larger, on–going study on cognition and oral health in later life in Appalachia, a sample of dentate, older adults without dementia aged 70 and above (n=245, 86 men and 159 women) received an oral assessment by either a dentist or dental hygienist. Psychometricians assessed cognition using a standardized battery of neuropsychological tests. They also administered the General Oral Health Assessment Index and conducted structured interviews concerning diet, oral hygiene practices, oral health, social support, income and years of education

Results: Over 80% of women (n=128) and 52.3% of men (n=45) reported brushing their teeth twice daily. Multivariate logistic regression analysis was conducted, controlling for socioeconomic status, social support (i.e., frequency of contacting friends and relatives), general oral health assessment items, number of decayed, missing and filled surfaces, plaque index and having regular dental visits. The results showed that women reported more frequent tooth brushing than their male counterparts (OR=4.04, 95% CI:1.93,8.42).

Conclusion: Older women in West Virginia had significantly better oral hygiene practices than older men, particularly regarding tooth brushing. Interventions are needed to improve older men's dental hygiene behaviors to improve overall oral health outcomes.

Keywords: Aged, self–care, gender differences, preventive behavior, Appalachia, oral hygiene

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

lis).[2,15] Local factors in the biofilm influence the type of bacteria in the plaque.[16] Older adults are at particular risk due to the number of medications they use, and the nature and quantity of their saliva. A report using the National Health and Nutrition Examination Survey (NHANES) 1999 to 2004 reported

the prevalence of periodontitis among dentate older adults 65 to 74 years old was 10.20%.[4] This was a significant overall decrease in prevalence from 19.57% in the NHANES (1988 to 1994) report, but there continued to be a greater prevalence of men with periodontal disease (12.97%, 8.56%, respectively, p<0.05).[4] The same study reported prevalence of carious lesions remaining high but stable for older adults (93.25%), with no gender differences.[4] The prevalence of mean number of permanent teeth for older adults 65 to 74 years was stable since 1988 (19.34%), but women had statistically fewer teeth than men (19.03, 18.77, respectively, p<0.05).[4]

The NHANES survey, along with other studies, indicate that more older adults are preserving their natural teeth and maintaining functional dentition.[4,17,18] However, there is dissatisfaction with oral function related to eating problems (the number and location of teeth) xerostomia, use of partial dentures and poor esthetics.[19] Adherence to the American Dental Association and the US Surgeon General Oral Hygiene Self–care recommendations to brush twice and floss at least once a day (good oral hygiene self–care) and have regular prophylactic dental hygiene visits have been associated with improving the plaque–mediated conditions of periodontal disease and dental caries, as well as improving tooth retention.[20-22] Nevertheless, as noted above, there are gender differences in oral health and disease. Studies indicate that oral hygiene self–care can manage the biofilm by mechanically removing the oral plaque biofilm mass, lowering the bacterial load, oxygenating the site and changing the ecology of the biofilm.[11] The process can be achieved with good oral hygiene self–care – brushing, rinsing, scraping and flossing or using other inter–dental cleaning.[11] There is little available research on differences in older adult oral hygiene self–care behavior between genders in their management of the plaque biofilm. One Danish study, which included adults of all ages, found women reported better oral hygiene self–care (e.g., frequency of tooth brushing and daily flossing) than men while controlling for socioeconomic status and dental status.[23] A Kuwaiti study of adults of all ages also indicated women reported better oral hygiene self–care.[24]

Given the importance of oral hygiene self–care with regard to oral health, and the scarcity of research concerning older adult gender differences in self–care behaviors, this study was undertaken to assess the differences between older men and women in a region in the U.S. with limited access to dental professionals. From results of previous studies on adults of all ages, it was hypothesized older women would have more frequent oral hygiene self–care than men. Poor oral hygiene self–care results in poor oral health, and it is a modifiable health behavior, thus, having the knowledge of any differences in behavior between older men and women can be useful in designing appropriate interventions and programs specific to the at–risk population.[20-22] Having the information may also be helpful in developing policies concerning the use of limited dental resources.

Methods and Materials

Participants were part of a larger study on oral health and cognition among older adults in West Virginia. The West Virginia University Institutional Review Board approved all procedures, and informed consent was obtained from participants. Participants were compensated with a $50 gift certificate to a local merchant. A convenience sample of non–institutionalized older adults aged 70 and above was recruited using statewide newspaper and television advertisements, fliers placed in primary care offices, libraries and churches, and given to directors of senior citizen centers, retirement homes and senior assisted–living homes. The research team made presentations at various locations throughout the state to inform older adults about the relationship between oral health and systemic diseases, details of the proposed research study on oral health and cognition in older adults and the importance and benefits of participating in research. Details of the recruitment process have been described elsewhere.[25] The participants were dentate and each had at least 4 natural teeth. Psychometricians administered batteries of neuropsychological instruments to determine the cognitive status of participants. The sample consisted of 245 non–demented older adults from various locations across West Virginia.

Psychometricians administered a 12 item General (previously Geriatric) Oral Health Assessment Index (GOHAI) to identify the impact of each participant's dental condition on specific issues (functional limitations, pain and discomfort and psychological impacts). Participants were interviewed, using a structured questionnaire. The questionnaire included questions on socio–demographics, social support, self–rated oral health status, physical status, health behaviors and oral hygiene self–care behaviors.

Measures

Dependent variables

Oral hygiene self–care was measured by self–reported frequency of tooth brushing, flossing and use of mouth rinse. The scale was 1=twice a day

or more, 2=once a day, 3=several times a week, 4=once or less than once a week or 5=intermittently or hardly ever.

Independent variable and other covariates

Socio–demographic characteristics included age, gender, marital status (married or living with partners=1, and otherwise=0), education and annual income. Social support included contact with relatives and friends. Contact with relatives was measured by number of family members that the respondents saw or heard from at least once a month, with a response from none to 9 or more contacts. The same response options were offered for the question concerning monthly contacts with friends. The study assessed dietary behavior using 3 questions that asked about the frequency of consumption of vegetables, fish and sweets. Each question had responses from never to 5 or more times a day. These questions were designed to briefly assess key dietary components and were drawn from the NHANES 2003 to 2004, in consultation with geriatricians, geriatric dentists and dental researchers.

Oral health measurements included a respondent's self–rating of oral hygiene self–care, as well as the results from the clinical assessment. The clinical assessment measurements were plaque index, number of decayed, missing and filled surfaces (DMFS), as well as the 12 items of GOHAI. The GOHAI items were summed for the multivariate analysis with a possible range of scores between 1 and 60. A higher score indicated better self–rated oral health. For the descriptive analysis, the GOHAI items were dichotomized as having symptoms vs. not having symptoms.

A dental scientist provided training on the evaluation procedures to the examiners (3 dentists and a dental hygienist) based on guidelines from the NHANES. Each examiner evaluated the same patient and then the dental scientist called all of the examiners to the patient to resolve any discrepancies and to determine final outcomes. The buccal surface of the most anterior molar in each quadrant and the facial surfaces of the maxillary right central incisor and the mandibular left central incisor were visually assessed as a part of the dental evaluation. Scores ranged from 0 (no plaque) to 3 (an abundance of soft matter within the gingival pocket and gingival margin).[26,27] As an assessment of inter–rater reliability, the average percent agreement for the number of missing teeth, the number of caries or restorations and the extent of periodontal disease (using the usual method of within +/−1 mm leeway) were calculated. The average inter–rater agreement was 98.1% for the number of missing teeth, 95.6% for the number of caries or restorations and 95.1% for the extent of periodontal disease.

SAS 9.1 (SAS Institute Inc. Cary, NC) was used to analyze the data. T–test and Chi–square procedures were conducted to compare frequency and mean differences between male and female respondents in oral health preventive practices. Ordinal logistic regression was performed for the outcomes: frequency of tooth brushing, use of mouth rinse and frequency of tooth flossing.

Results

The sample included 86 men and 160 women who were non–institutionalized older adults without dementia. The mean age was 78 years of age. Fewer women were married or lived with a partner than men (33.1% and 62.8%, p<0.0001). More women had less than 12 years of education than men (19.4% and 5.8%, p=0.004). More women had an income of under $20,000 than men (47.6% and 19.5%, p<0.0001).

Men and women did not differ significantly in DMFS (Table I). The 2 groups did not differ significantly in self–rated oral health. Nearly 26% of males and 31% females reported their overall oral health as fair or poor.

Gender differences in oral hygiene self–care indicated a higher proportion of older adult women brushed their teeth more frequently than their male counterparts (Chi–square=23.19, p<0.001, Table I). Eighty–one percent of women reported brushing their teeth twice a day, while the percentage for males was 52%. Compared to brushing, participants reported lower frequency of flossing and mouth rinsing. Forty–four percent of males and 32% females reported flossing intermittently, and the percentage for mouth rinsing was 41% and 37%, respectively.

Ordinal logistic regression results also showed females reported more frequent tooth brushing than their male counterparts (OR=4.04; CI:1.93, 8.42, Table II). Other factors, such as more regular dental checkups, were associated with more frequent tooth brushing (OR=1.29, 95% CI:1.02,1.64). A lower plaque index score was also related to higher frequency of tooth brushing (OR=0.53, 95% CI: 0.32, 0.86).

Similar to brushing, compared to males, females also reported a higher frequency of tooth flossing (OR=2.03, 95% CI:1.14, 3.63, Table III). Individ-

uals with higher income and more recent dental check-ups were also more likely to have a higher frequency of flossing. No significant differences in mouth rinsing between males and females were found in the multivariate analysis model.

Discussion

In this study, women were more likely to brush their teeth twice a day than men. This supports a similar study which indicated that females, higher education, certain oral health beliefs, income and a source of care had higher oral hygiene scores than those who did not.[28]

The majority of respondents rated their oral health as good to excellent, despite the respondents having, on average, a large number of DMFS. This apparent inconsistency may be reflective of age, geographic location and/or cultural influences of the population studied. The geographic region of Appalachia has significant problems with carious lesions and other oral health concerns.[7] Moreover, the discrepancy between perceived oral health and DMFS suggests a culture in which the participants have unique oral health values, where retention of natural dentition may not be a priority.[29]

The overall oral hygiene self-care of the participants indicated a need for both men and women to improve in their frequency of brushing and flossing. Dentists and dental hygienists are aware that poor oral hygiene, inappropriate diet, smoking, drinking, hyposalivation and poor host defenses are some of the causes of local changes in plaque leading to the com-

Table I: Self-reported Oral Health Preventive Practices

n=245	Male (86)	Female (159)	Chi-square/T value	p-value
Toothbrushing frequency			23.19	<0.001
• Twice daily	52.3%	80.5%		
• Daily	43.0%	18.9%		
• Several times/week	2.3%	---		
• Once/week	---	---		
• Intermittent	2.3%	0.6%		
Flossing frequency:			6.91	0.14
• Twice daily	12.8%	12.0%		
• Daily	30.2%	32.1%		
• Several/week	7.0%	17.6%		
• Once/less/week	5.8%	6.3%		
• Intermittent	44.2%	32.1%		
Mouthrinse frequency:			8.00	0.09
• Twice daily	20.9%	10.7%		
• Daily	22.1%	32.7%		
• Several/week	9.3%	14.5%		
• Once/week	7.0%	5.0%		
• Intermittent	40.7%	37.1%		
Last dental checkup			6.57	0.25
• 0–6 months ago	73.3%	63.5%		
• 6–12 months ago	15.1%	13.2%		
• 1–2 years ago	2.3%	6.3%		
• 2–3 years ago	2.3%	6.3%		
• 3–5 years ago	3.5%	2.5%		
• More than 5 years	3.5%	8.2%		
Frequency of sugary foods			7.76	0.26
• Never	23.5%	37.5%		
• 1–3/month	35.3%	33.8%		
• 1–2/week	28.2%	18.1%		
• 3–4/week	7.1%	3.8%		
• 5–6/week	1.2%	1.3%		
• 1/day	4.7%	5.0%		
• 2/day	0.0%	0.6%		
Self assessment of Oral Health				
• Sum of GOHAI (12 Items)	58.4	58.8	3.28	0.51
Overall oral health				
• Excellent	7.0%	10.7%		
• Very good	34.9%	25.2%		
• Good	32.6%	33.3%		
• Fair	22.1%	25.8%		
• Poor	3.5%	5.0%		
Functional limitations (GOHAI items dichotomized)				
• Trouble biting/chewing	9.3%	5.0%	1.70	0.19
• Uncomfortable swallowing	8.1%	5.0%	0.96	0.33
• Impacts speaking	1.2%	1.9%	0.18	0.67
Pain and discomfort				
• Discomfort eating	16.3%	13.1%	0.46	0.50
• Use of medication for pain	0.0%	1.3%	1.08	0.30
• Sensitivity to hot/cold	4.7%	12.5%	3.91	0.048
Psychological impact				
• Unhappy with appearance	14.0%	13.8%	0.00	0.96
• Self-conscious	0.0%	6.3%	5.60	0.018
• Uncomfortable eating socially	1.2%	2.5%	0.50	0.48
Behavioral impacts				
• Limitation of food	4.7%	3.1%	0.37	0.54
• Limitation of social contacts	0.0%	1.3%	1.08	0.30
Clinical assessment				
• DMFS	83.2	80.2	0.78	0.44
• Plaque score	0.7	0.5	2.12	0.033

mon plaque–mediated diseases of caries and periodontal disease.[2] Of those factors listed, interventions may be possible to modify diet and drinking, reduce smoking, aid with salivary moisturizers or medications to improve salivary flow and to improve oral hygiene self–care. There is a need for clinicians to develop and promote holistic, patient–specific strategies to maintain homeostasis with appropriate oral self–care behaviors for older adults.[2] The strategies need to address gender differences in tooth brushing and flossing behavior for both older men and women, as well as disparities that may exist due to location or culture. Historically, for the men and women in this sample, there may have been less emphasis on oral hygiene self–care when they were children in the 1940s or earlier. The DuPont company began to mass produce nylon toothbrushes in 1938, and although Dr. Levi Spear Parmly suggested silk thread use to clean teeth in 1815, nylon floss and flossing only became widely available and used after World War II, primarily through the efforts of Dr. Charles C. Bass.[30] Socialization to oral hygiene self–care is thought to be most efficacious early in life, and self–care habits are resistant to change.[31] As a result, older adults may need more time, help, encouragement and modifications when given oral hygiene instructions for self–care, and more time may be needed with older men to impress the need for more frequent and better tooth brushing to prevent carious lesions and periodontal disease.

The study results are consistent with the literature on preventive medical care.[32,33] Some researchers speculate that women's more frequent preventive health behaviors relate to their acceptance of help–seeking and compliance with treatment regimens.[34] These speculations are further tested by empirical studies that these differences may result from individuals' health beliefs and help–seeking behavior.[32,33] Thus, targeting health attitudes and behaviors that vary with gender might be the most effective strategies for producing changes in dental self–care.

Limitations to the study include the use of a cross sectional design, which does not permit causal analysis. Therefore, any attempt to generalize this study's findings should be interpreted with caution. Similar to another studies of this type, the self–reported information is subject to recall error. Although not a limitation, per se, it should be noted that the study consisted of more females than males. The ratio of females to males (64.9%) was similar to that in the U.S. overall, where, for those aged 65 and older almost 60% are women.[35]

Table II: Logistic Regression Results on Tooth Brushing

	Odds Ratio (95% CI)
Demographic Factor	
• Age	1.00 (0.94 1.07)
• Female	4.04 (1.93 8.42)
• Married Status	0.54 (0.24 1.20)***
• Education	1.03 (0.74 1.42)
• Income	1.16 (0.89 1.51)
Social Support	
• Frequency of contacting friends	1.21 (0.11 1.61)
• Frequency of contacting relatives	1.22 (0.91 1.63)
Dietary Behavior	
• Vegetable	0.93 (0.75 1.16)
• Fish	0.72 (0.44 1.18)
• Sweet consumption	0.78 (0.60 1.01)**
Oral Health	
• Sum of GOHAI (12 items)	1.03 (0.97 1.10)
• DMFS	0.99 (0.98 1.01)
• Plaque Index	0.53 (0.32 0.86)*
• Last dental checkup	1.29 (1.02 1.64)*

Note: *p<0.05, **p<0.01, ***p<0.001

Table III: Logistic Regression Results on Tooth Flossing

	Odds Ratio (95% CI)
Demographic Factor	
• Age	1.01 (0.97 1.06)
• Female	2.03 (1.14 3.63)*
• Married Status	1.16 (0.64 2.11)
• Education	1.01 (0.79 1.29)
• Income	1.28 (1.05 1.57)*
Social Support	
• Frequency of contacting friends	1.01 (0.80 1.27)
• Frequency of contacting relatives	0.87 (0.70 1.08)
Dietary Behavior	
• Vegetable	1.06 (0.89 1.25)
• Fish	1.17 (0.82 1.69)
• Sweet consumption	0.82 (0.66 1.02)
Oral Health	
• Sum of GOHAI (12 items)	1.02 (0.97 1.07)
• DMFS	1.00 (0.99 1.01)
• Plaque Index	0.83 (0.56 1.25)
• Last dental checkup	1.37 (1.13 1.66)**

Note: *p<0.05, **p<0.01

Conclusion

As the U.S. population ages, more emphasis will be placed upon the health needs of older adults, particularly those in geographic areas with limited access to care and unique oral health perspectives.

Dental hygienists and dentists are in a special position to provide the skills, tools and techniques to improve or maintain oral health in older adults. The older females in this study reported better oral hygiene practices than the males. Therefore, an even greater effort is needed to work closely with older male patients to educate, encourage and motivate them in their oral hygiene practices. As health care providers who have an extended period of time with patients, dental hygienists are able to provide information about nutrition, smoking and lifestyle influences, which can be used by older patients not only to maintain their teeth, but to maintain or improve their quality of life. Older patients provide unique challenges and rewards and understanding their needs will be a particularly important aspect of oral care in the future.

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Acknowledgments

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Research

Vital Tooth Whitening Effects On Oral Health–Related Quality Of Life in Older Adults

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Introduction

Vital tooth bleaching, the act of using hydrogen peroxide or carbamide peroxide to whiten teeth, is the most commonly requested cosmetic dental procedure in the U.S.[1] The American Academy of Cosmetic Dentistry's survey on cosmetic procedures performed from 2005 to 2006 showed a 57% increase in tooth whitening.[2] Capitalizing on consumer interest, dental practices are marketing as specialists in cosmetic or aesthetic dentistry. Since 97% of cosmetic dental practices reported profits from tooth whitening in 2006, determining the effects of whitening on oral health–related quality of life (OHRQOL) is important to investigate.[2] OHRQOL is the absence of negative impacts of oral conditions on social life, and a positive sense of dentofacial self–confidence.[3] Quality of life research in relation to dental aesthetics has thus far focused mainly on university students, and no published research was found that focused on the effects of vital tooth bleaching on quality of life in an older adult population.

The Centers for Disease Control and Prevention (CDC) estimate the population ages 50 to 85 and older will reach approximately 3 billion by year 2030.[4] A trip to the dentist can be discouraging due to access barriers such as transportation, cost and dissatisfaction with the way their teeth look, feel or function.[5] The American Academy of Cosmetic Dentistry reported that adults 51

Abstract

Purpose: The purpose of this study was to determine if vital tooth whitening affects oral health–related quality of life (OHRQOL) in adults age 50 years and older, and if tooth whitening causes increased participation in social activities.

Methods: Using a 2 group, single blind, randomized, pre–test, multiple post–test design, 62 participants were enrolled. The experimental group used a whitening product twice daily for 3 weeks. The control group used no whitening products. The Oral Health Impact Profile (OHIP) served as the pre– and post–test measure. The OHIP measures OHRQOL on 7 subscales: functional factors, psychological disabilities, psychological discomforts, physical disabilities, social disabilities, handicaps and physical pain. Additional questions measured the subjects' social activities at baseline, 3 weeks and 3 months. Data from 53 participants, who completed the study, were analyzed using paired t–tests and ANOVA at $p=0.05$.

Results: Statistical significance was observed for the OHIP physical pain subscale ($p=0.0029$) and the handicap subscale ($p=0.05$). Pre– to post–test means of the physical pain subscale increased in the experimental group (4.84 to 7.10), suggesting a lower OHRQOL, most likely related to tooth sensitivity experienced by the experimental group. Means from pre– to post–test of the handicap subscale (1.96 to 1.19) reveal that the experimental group reported an improved OHRQOL and felt they were more willing to work. Repeated measures ANOVA and Tukey's post–hoc tests revealed that the experimental group reported significantly less ($p=0.04$) social activities at the 3 month post–test (3.92 to 3.45). No statistically significant between–group differences were observed in the overall OHIP score for functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities.

Conclusion: Results indicate that vital tooth whitening does not improve overall OHRQOL in older adults.

Keywords: Tooth whitening, middle aged, oral health related quality of life (OHRQOL), Oral Health Impact Profile (OHIP)

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Validate and test assessment instruments/strategies/mechanisms that increase health promotion and disease prevention among diverse populations.

years of age and older partook in 34% of cosmetic dentistry procedures in 2006.[2] Since tooth whitening is noninvasive and relatively inexpensive, it is important to examine its impact on quality of life in an older population. Higher quality of life from a whiter and brighter smile might lead to increased dental visits and increased concern for the health of the oral cavity. In the present study, data were collected on older adults via the Oral Health Impact Profile (OHIP) and compared to research on OHRQOL and tooth whitening on college–age students.

Table I: OHIP Subscales

OHIP Subscales	Assessment
Functional limitation	Feeling as if problems with the teeth affect overall appearance
Physical pain	Experiencing headaches due to problems with the teeth or tooth sensitivity
Psychological discomfort	Feelings of worry or self–consciousness due to problems with the teeth
Physical disability	Experiencing a reduced ability to eat and avoidance of smiling due to problems with the teeth
Psychological disability	Feelings of depression and embarrassment because of problems with the teeth
Social disability	Avoiding social situations and inability to get along with others due to problems with the teeth
Handicap	Feeling of reduced ability to work due to problems with the teeth

Attractiveness and its Effects on Self Consciousness

Physical attractiveness, in particular facial appearance, has been shown to be significant to body image and self consciousness.[6] Teeth are a predominant facial feature and play an important role in overall physical attractiveness. Dissatisfaction with how one's own teeth look may result in loss of eye contact and anxiety.[6] Following the placement of anterior composite restorations, individuals who were previously dissatisfied with the appearance of their teeth had increased self–esteem and reported feeling more comfortable in social scenarios as evidenced by the Body–Esteem Questionnaire.[6]

Research suggests that society judges based on appearance even when other personality traits or abilities are known.[7] The most important factor in assessing one's self–image is acceptance and perceptions from peer groups.[7] Based on appearance alone, older adults are often deemed feeble, unstable and less flexible individuals.[7] A meta–anayl1tic and theoretical review on attractiveness found that adults who thought of themselves as physically attractive self–reported as healthier and more efficient.[8] Attractiveness was also found to be significant within the work and school environment.[8] Researchers concluded that facial attractiveness has an effect on self–consciousness, as attractive adults were found to have higher self–confidence and self–esteem.[8]

Older Adults and OHRQOL

Researchers found that physical health has profound quality of life implications.[9] Being social is important for overall general health and increased quality of life in older adults. Physical pain associated with dental diseases and disorders, and feelings of embarrassment from unattractive teeth, can decrease social interaction in older adults, thereby decreasing quality of life.[10] In a research study by Ekanayke et al, 235 participants 60 years of age and older underwent oral examinations and were interviewed on socio–demographic data, perceived oral health status, perceived need for dental care, dental visiting pattern and psychosocial impact of oral disorders on well–being and quality of life.[11] This study demonstrated that OHIP data was useful for determining how older adults view their own oral health status.[11]

Effects of Tooth Whitening on OHRQOL

McGrath and colleagues studied whitening effects in 87 college–aged individuals. At baseline, participants completed the OHIP, which assessed functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap (Table I).[12,13] Eight weeks after using whitening products, 63 participants returned for post–testing. Researchers found that the OHIP was "sensitive and responsive" to whiter teeth, meaning whiter teeth positively affected OHRQOL.[12] Of the 7 variables, the functional limitation subscale changed significantly after participants' teeth were whitened, meaning they reported less difficulty chewing and better overall appearance of their teeth.[12]

Slade et al explained the use of the OHIP in the measurement of quality of life based on 7 sub-

Table II: Research design

Pre–Test Measures Baseline	Treatment	Post–Test Measures Week 3	Post–Test Measures Three Months	Final Sample
Experimental Group • Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Use of a tooth whitening product • Oral home-care instructions	• Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Additional Questions Survey (AQS)	• Females: 10 • Males: 14 • Total: 24
Control Group • Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• No use of tooth whitening product • Oral home-care instructions	• Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Additional Questions Survey (AQS) • Given tooth whitening product	• Females: 18 • Males: 11 • Total: 29
				• Total: n=53

scales in 64 dental patients, which showed validity and reliability.[13] Outcomes provide information to better understand the dimensions of OHRQOL and factors that encourage dental care seeking behaviors in older adults. This is due to the fact that OHIP reliability in the study performed by Slade et al was performed on 122 individuals over the age of 60.[13] The purpose of the present study was to determine if prescription strength at–home tooth whitening lead to self–reported tooth color satisfaction, improved overall OHRQOL and lead to increased social activities in older adults.

Methods and Materials

Research Design

A 2 group, single blind, randomized, pre–test, multiple post–test design was used for the present study (Table II). Sixty–two participants 50 years of age and older were enrolled and randomly assigned to 1 of 2 groups by research assistants. A total of 53 participants completed the study (Table II). Clinicians collecting data were unaware of participant group status, since the participants were assigned a number after being randomly assigned to a group. Research assistants informed participants not to discuss treatment with clinicians. Since the control group did not utilize a whitening product and the experimental group did, both groups were aware of their status within the study. The whitening product used, (Crest Whitening Supreme® 14%; Procter & Gamble, Cincinnati, Ohio) has demonstrated safety and effectiveness.[14,15]

Sample Description, Selection and Enrollment

The convenience sample of 62 adults 50 years of age and older were enrolled from the Hampton Roads area of Virginia. This sample size was chosen to obtain at least 30 participants in each group for use of parametric statistics. Participants had to be in good general health, possess the cognitive ability and physical dexterity to perform daily oral care, have at least 8 natural anterior teeth free from composite restorations, crowns, veneers, full or partial dentures and endodontic treatment, and refrain from using any over–the–counter tooth whitening products for the duration of the study. Exclusion criteria included visible calculus deposits on labial or lingual surfaces of anterior teeth covering more than one third, severe tooth sensitivity or professional whitening within the past 3 years. Exclusion and inclusion criteria were determined through a researcher–conducted screening process.

Procedures and Materials

Tooth color assessments using the Tooth Color Shade Guide (TCSG) on teeth numbers 6 through 11 and 22 through 27 were measured at the middle third and recorded. The TCSG consisted of 12 shades numbered from 1 to 12, with 1 being the lightest and 12 being the darkest (Trubyte New Hue Vitality Scale®, Dentsply International, York, Penn).

Data Collection Instruments

Tooth color satisfaction, measured with the Tooth

Color Satisfaction Scale (TCSS), asked the question "How satisfied are you with the color of your teeth?" Responses ranged from very satisfied (5 points), satisfied (4 points), neither satisfied nor dissatisfied (3 points), dissatisfied (2 points) and very dissatisfied (1 point). Calibration for measuring tooth color was conducted prior to study initiation. Test–retest data were analyzed using percentages and both intra–rater reliability (examiner 1=100%, examiner 2=90%) and inter–rater reliability (99.44%) were considered excellent.

OHRQOL measured the frequency of dental–related problems utilizing a reference period of 1 month and a 5 point Likert scale: very often (5 points), fairly often (4 points), occasionally (3 points), hardly ever (2 points), never (1 point), don't know and not applicable.[13] Questions with responses of don't know and not applicable were not included in the analysis. The instrument yields an interval scale of 0 to 196 for overall quality of life – the lower the score, the higher the OHRQOL since the OHIP weights negative factors. OHIP measured overall quality of life and its 7 subscales: functional factors (0 to 36), psychological disability (0 to 24), psychological discomfort (0 to 20), physical disability (0 to 36), social disability (0 to 20), handicap (0 to 36) and the feeling of pain or discomfort (0 to 36). The OHIP is "one of the most comprehensive measures of OHRQOL," and determined the primary endpoints of whether or not overall quality of life and it's 7 subscales increased within the experimental group, demonstrating that whiter teeth positively impacted quality of life.[12]

The number of self–reported social activities for older adults measured by a researcher–created Additional Question Survey (AQS) asked, "How many social activities (with a group or with one other person) did you participate in over the past two weeks?" Responses ranged from none (1 point), 1 to 2 (2 points), 3 to 4 (3 points), 5 to 6 (4 points) and 7 or more (5 points).

Protection of Human Subjects

The University's institutional review board approved the protocol for protection of human participants. All participants were informed verbally and in writing of the potential risks, benefits, procedures, protection of subject rights and the risk–benefit ratio, and signed informed consent.

Table III: Pre–test to Post–test Tooth Color Satisfaction

	Degrees of Freedom	Sums of Squares	Mean Squares	F–Statistic	p–Value
Pre–Test Scores	1	0.10	0.10	0.20	0.66
Error	51	25.79	0.51		
Corrected Total	52	25.89			
Post–Test Scores	1	39.57	39.57	50.05	<0.0001
Error	48	37.95	0.79		
Corrected Total	49	77.52			

Statistical Analysis

Data were entered into Microsoft Excel software, and SAS statistical analysis software. Pre– and post–test scores measuring tooth color change as a result of the whitening treatment in the experimental group were also included. Between group differences were analyzed using analysis of variance (ANOVA) for tooth color and tooth color satisfaction, while scores from the OHIP measure were analyzed using the paired t–test. Two–way analysis of variance determined the differences between the pre– and the post–test for each group. To correlate tooth color satisfaction with the overall score, regression analysis was used. This also determined if tooth color satisfaction scores affected overall OHRQOL within groups. For the additional question, repeated measures ANOVA and post–hoc comparisons with Tukey's test were performed.

Results

A 36.8% improvement in tooth color for the experimental group was found over 3 weeks. TCSS analysis revealed that older adults in this group were significantly more satisfied with the color of their teeth than those in the control group. At baseline, individual groups were equivalent in the satisfaction of their tooth color. Post–test scores in tooth color satisfaction for the experimental group increased significantly from 2.29 to 4.36, suggesting that persons who had their teeth whitened became more satisfied. Data revealed that individuals who received the whitening treatment showed significant increases in tooth color satisfaction (Table III).

OHRQOL analysis revealed no statistically significant difference in the experimental group compared with the control group after the whitening treatment. Paired t–test results for the control group using the log scores of the difference from pre– to post–test showed no statistically significant improvement in overall quality of life (t–val-
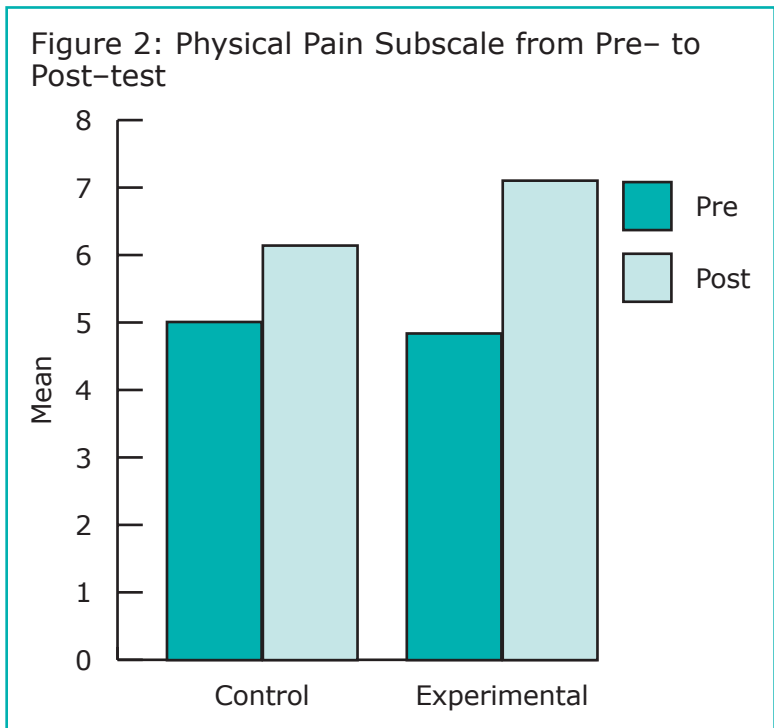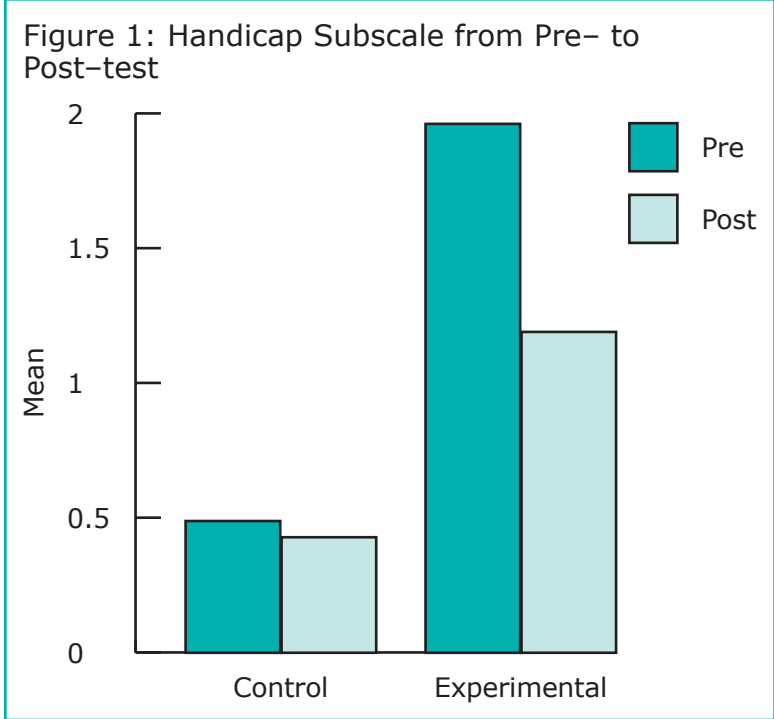
ue=−1.10, df=28, p−value=0.28). Paired t−test results for the whitening group showed no statistically significant difference (t−value=1.27, df=23, p−value=0.22). The overall quality of life difference score from pre− to post−test was 0.96 (n=24). At baseline, the control group had a slightly higher OHRQOL (18.14 and 20.67). Tooth whitening did not influence overall quality of life.

Statistical significance was not observed for the OHIP functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities subscales. Analysis of the handicap subscale of the OHIP revealed that older adults in the experimental group became statistically more willing to work due to a perceived increase in health compared to the control group. Paired t−test results for the experimental group showed a statistically significant improvement in the handicap subscale from pre− to post−test (p=0.05). No statistically significant difference occurred when the handicap subscale OHIP pre− and post−test means for the control group were analyzed (p=0.63, Figure 1). Baseline comparisons made for the handicap subscale revealed a statistically significant difference between the experimental group and the control group (p=0.03), suggesting that the 2 groups had varying handicap subscale results.

Analysis of the physical pain subscale of the OHIP revealed significantly more physical pain in the experimental group, since a statistically significant change for the worse (more pain was experienced) was shown (p=0.0029). No statistically significant change occurred in the control group (p=0.08, Figure 2). Baseline comparisons for the experimental group showed initial group equivalency (p=0.90).

Analysis of the number of social activities participated in over the past 2 weeks revealed a significant difference among older adults in the experimental group as measured by the AQS. Repeated measures of ANOVA showed no statistically significant interaction between treatment group and time, indicating the profiles of the means were parallel (p=0.95, Figure 3). Statistically significant differences were observed between groups (p=0.04) and between time (p=0.01), and both groups changed similarly.

A post−hoc test (Tukey's test) was conducted

Figure 1: Handicap Subscale from Pre− to Post−test

Figure 2: Physical Pain Subscale from Pre− to Post−test

to identify the significant time periods from the group differences. When comparing the control and experimental group from baseline to 3 weeks (p=0.40) and baseline to 3 months (p=0.21), no significant changes were found. Significance was found when comparing the control and experimental group means from 3 week to 3 months (p=0.01). Although still higher than the control group, the experimental group experienced slightly less social activities from post−testing at 3 weeks to 3 months.

Relationships among tooth color satisfaction scores and overall OHIP scores were analyzed using regression analysis. At baseline, the control group showed no statistically significant correlation (p=0.93) in overall OHIP and tooth color satisfaction scores. As the tooth color satisfaction scores increased, the overall OHIP scores stayed about the same. Moreover, there was no statistically significant relationship (p=0.56) among the control group's tooth color satisfaction and overall OHIP scores at the 3 week post–test. Even though results were not significant, the control group demonstrated that within 3 weeks, tooth color satisfaction increased and OHRQOL increased (OHIP scores decreased). Correlations between the experimental group tooth color satisfaction and overall OHIP scores at baseline showed a statistically significant relationship (p=0.01). As tooth color satisfaction increased, OHRQOL increased (OHIP scores decreased).

At 3 weeks the experimental group revealed a statistically significant correlation between tooth color satisfaction and overall OHIP (p=0.01). As seen in Figure 4, tooth color satisfaction increased and OHIP scores significantly decreased (higher OHRQOL). An increase in the satisfaction of one's teeth demonstrated a significant correlation with higher quality of life.

When accounting for the pre– and post–test differences of the experimental group, no statistically significant correlation occurred between the overall OHIP score and tooth color satisfaction (p=0.48). Tooth color satisfaction increased significantly in the experimental group over 3 weeks.

Discussion

In general, all participants were low on the OHIP scale indicating a high quality of life at baseline. Tooth whitening positively changed older adults' perceptions of their teeth and they became more satisfied with their tooth color. The results were similar to McGrath et al, where over half of participants reported being more satisfied with the color of their teeth after tooth whitening.[12]

Overall oral–health related quality of life was not changed as a result of tooth whitening, which contrasts McGrath et al where overall OHIP results improved significantly after tooth whitening.[12] These overt differences might be explained due to the fact that the control group demonstrated a higher overall OHIP result than the experimental group. Although not statistically significant, the experimental group had a lower OHRQOL, while the

Figure 3: Average Social Activities Scores of Control and Experimental and Time at Baseline, 3 Weeks and 3 Months
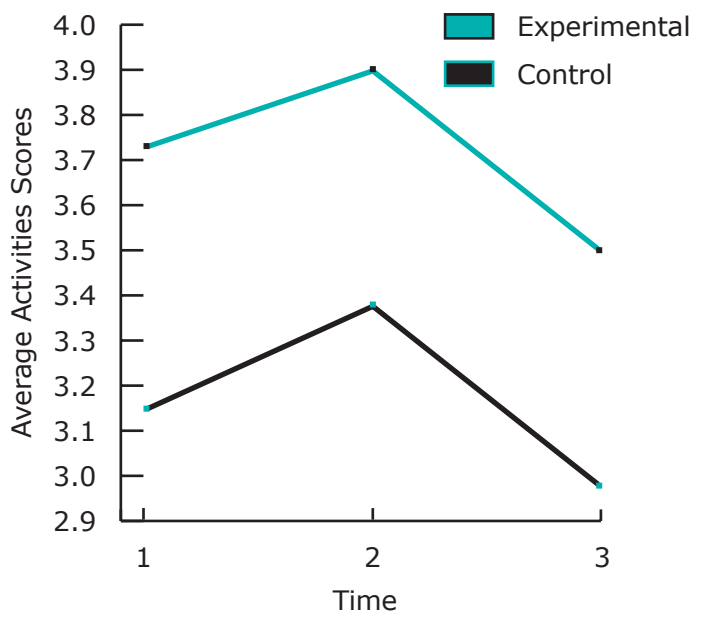
control group showed higher OHRQOL. Reasons for this could be due to the statistically significant decrease in OHRQOL for the physical pain subscale of the OHIP within the experimental group. The control group also showed a statistically non–significant increased mean score (lower OHRQOL), but the increase shown in the experimental group was much higher, unlike McGrath et al.[12] This increase in pain is most likely attributed to the tooth sensitivity that is common with whitening procedures. The functional factors subscale of the OHIP showed no statistically significant differences, therefore, those who whitened their teeth did not report increased confidence in their appearance. This is unlike McGrath et al, where significance was concluded for the functional limitation subscale.[12] The psychological disability subscale of the OHIP yielded no statistically significant difference from pre– to post–test in the experimental group. The control group showed improved OHRQOL for the psychological disability subscale, but this was not statistically significant. This may be attributed to a history threat, where the control group participants absorbed information regarding tooth whitening during the 3 week period and related this to the questionnaire. The physical disability subscale revealed that participants did not experience an increased ability to perform daily oral hygiene or to smile. Initial group equivalence was established, yet the control group experienced a greater decrease in the mean score from OHIP pre– to post–test (2.16 to 1.34) and showed a higher OHRQOL for the subscale (p=0.09). This is most likely due

Figure 4: Relationship Between Tooth Color Satisfaction and Overall OHIP Scores for the Experimental at Three–week Post–test
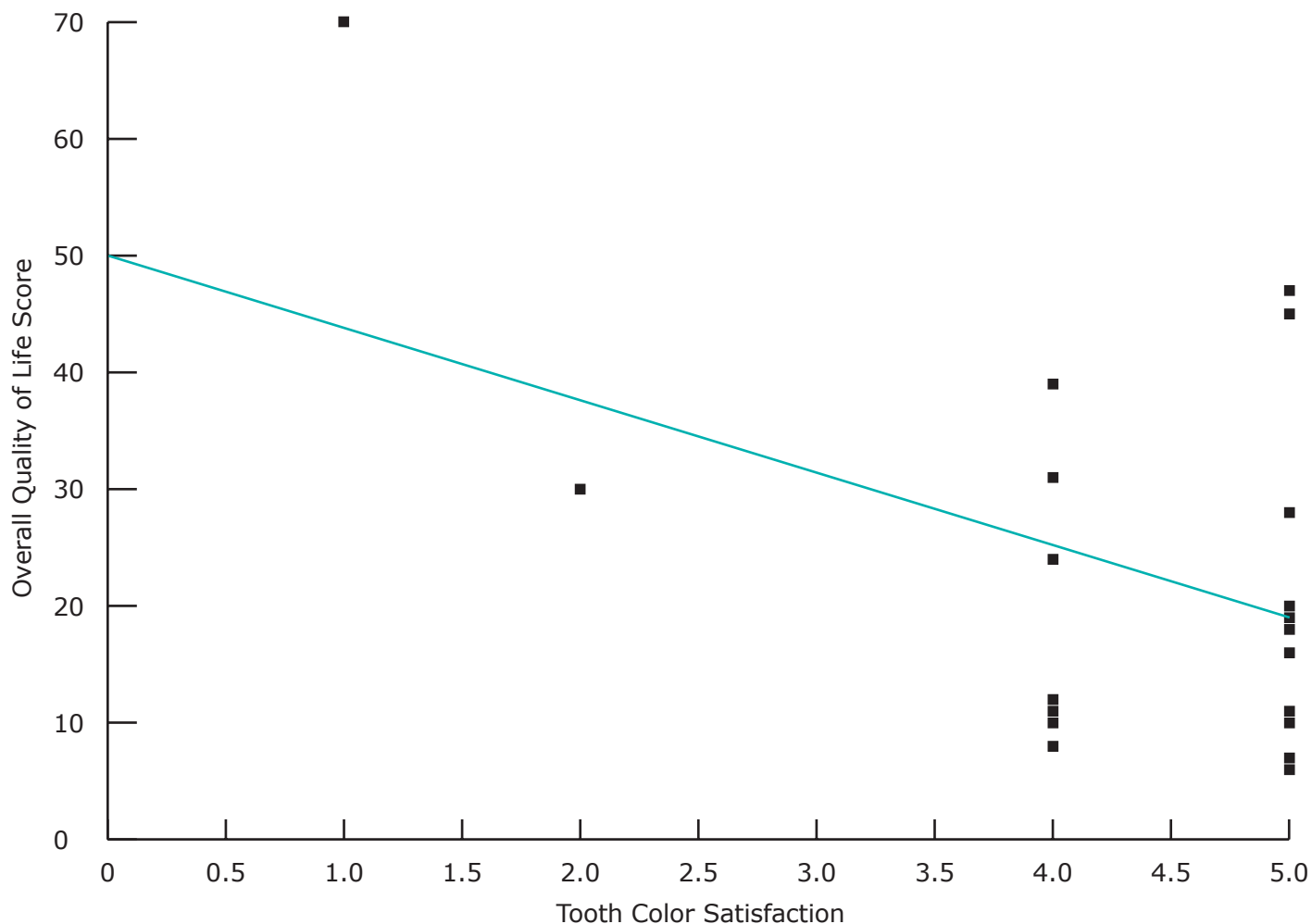
to the fact that participants were not disabled and were competent in performing daily oral hygiene to begin with.

Future studies should assess tooth color scores at baseline, then assign them to matched groups based on their pre–test score. This would give researchers initial group equivalency and a more precise assessment of a change in quality of life than was possible presently. The short–form OHIP (OHIP–14), used in the study done by Ekanayke et al may have had more room for error and has been shown to be equivalent to the 49 item questionnaire used in the present study.[11,16,17] Larger sample sizes, as well as random selection of samples, would allow future researchers to generalize results to a broader older adult population. As demonstrated by the present study and existing literature, the older adult population is interested in their tooth color. Future studies are recommended to further address psychosocial change in older adults associated with tooth whitening using larger sample sizes, a placebo, random selection and stratification.

Conclusion

Based on the outcomes of this study, the following is reported:

- The older adults who whitened their teeth experienced an increased satisfaction with their tooth color as evidenced by the TCSS
- Tooth whitening was not associated with improvements in overall OHRQOL, or its functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities subscales
- Tooth whitening did affect the handicap subscale, which demonstrated that persons who experienced tooth whitening were more willing to work due to a perceived increase in health
- Tooth whitening did affect the physical pain subscale, which demonstrated a lower OHRQOL for participants
- Older adults who whitened their teeth reported fewer social activities 3 months after the initial post–testing
- Regression analysis relating tooth color satis-

faction with overall OHRQOL revealed a significant correlation between tooth color satisfaction and overall OHIP for the experimental group

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Research

Massachusetts Dental Public Health Program Directors Practice Behaviors and Perceptions Of Infection Control

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Introduction

The Centers for Disease Control and Prevention (CDC) issued updated guidelines for infection control and disease prevention in 2003. Although these guidelines focus mainly on fixed dental settings, the recommended infection control practices are to be applied in all settings where dental treatment is provided.[1] Unlike a traditional fixed dental setting, public health settings utilizing portable or mobile equipment have additional factors to consider, such as limited resources (availability of sinks, water, electricity and space). These can have a direct impact on hand hygiene procedures, pre–cleaning/sterilization of dental instruments and disposal of contaminated waste.

Past and current research regarding dental infection control standards and challenges focus on traditional settings using fixed equipment. Public health settings may have varied issues that impact the delivery of care and infection control procedures. It is important to better understand predictors that influence lapses and adherence to existing standards. The purpose of this exploratory pilot study was to determine the current infection control practices used in Massachusetts dental public health programs and assess perceived compliance and challenges with infection control standards as outlined in the 2003 CDC guidelines.

Abstract

Purpose: The objective of this exploratory study was to determine the current infection control practices used in Massachusetts dental public health programs and assess the perceived compliance and challenges with infection control standards as outlined in the 2003 Centers for Disease Control and Prevention (CDC) infection control guidelines.

Methods: A convenience sample of program directors of dental public health programs in Massachusetts (n=82) were invited to participate. The directors were identified through the Massachusetts Department of Public Health, Massachusetts League of Community Health Centers, local dental/dental hygiene schools and key stakeholders in dental public health. The electronic questionnaire–based survey consisted of 26 open/closed–ended and Likert scale questions. Statistical analysis included frequency distribution and factor analysis.

Results: The overall response rate was 43%. The majority of responders to the survey were from public health settings using fixed/mobile dental equipment (82.9%), compared to settings using portable equipment (17.1%). Perceived lapses in the guidelines were attributed to lack of finances (r=0.938), lack of personnel (r=0.874) and lack of space (r=0.763). The only significant correlation between the program directors perceived adherence to the CDC guidelines was having access to necessary supplies and equipment (r=0.914). Program directors indicated that the CDC guidelines are hard to apply (r=0.895) and guidelines specific to settings using portable equipment would be helpful (r=0.925).

Conclusion: Within the limitations of the sample size and response rate, directors from public health settings using both fixed/mobile and portable equipment reported being able to apply the current 2003 CDC infection control guidelines with few compliance challenges. However, respondents indicated that the guidelines were hard to apply and that infection control guidelines for settings using portable equipment would be useful.

Keywords: Infection control, portable dental equipment, fixed dental equipment, safety–net programs, public health programs

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate methods to decrease errors, risks and or hazards in health care and their harmful impact on patients.

Access to oral health care is a significant problem for a large segment of the population in the U.S.[2-6] The most vulnerable affected individuals include the poor and the working poor, poverty–stricken inner–city residents, rural residents, ethnic minority groups, elderly, unemployed, uninsured, persons with special needs, mobility–restricted individuals and limited health literacy levels.[3,5-7] A 2000 Special Legislative report entitled The Oral Health Crisis in Massachusetts revealed a serious problem in access to oral health care in the state, especially for the poorest and most vulnerable populations. According to the report, more than 2.3 million residents do not have dental insurance, as evidenced by the 4,000 calls per month to the Division of Medical Assistance from members of MassHealth (a government assisted health insurance program) unable to find dental care.[8] Compounding the problem, 86% of practicing dentists are not active providers in MassHealth, thereby impacting access to care for almost 1 million residents enrolled in the program.[8] A major recommendation made from this report was to increase access to oral health screening and treatment services in both the public and private sector by expanding beyond the traditional private practice setting. These alternative settings, also referred to as safety–net programs, are located in community health centers, public health departments or schools, and provide services to groups of individuals that are unable to access and or afford care from the private sector.[4,9] Last reported in 2009, Massachusetts had 48 safety–net dental programs located in community health centers, public health departments and schools across Massachusetts that saw 377,577 patient visits per year.[10]

Over the past decade, many individuals, professional health organizations and advocacy groups have strived to improve the problem of access to oral health care for underserved populations. Three key national documents, *Oral Health in America: A Report by the Surgeon General, Healthy People 2010*, and the *National Call to Action to Promote Oral Health* all highlight the issues of access to care and the need to establish programs to eliminate oral health disparities.[2,3,6] Based on these recommendations, the Surgeon General invited all dental providers "To expand plans, activities and programs designed to promote oral health and prevent disease."[2] To meet the challenge of increasing access to oral health care, requests were made to expand safety–net programs located in non–traditional settings, such as health centers, schools, hospitals and community centers.[2-4,6,9]

There are primarily 3 types of practice settings for accessing dental care: fixed, portable and mobile. A traditional, fixed clinic facility is considered the most efficient and effective for providing direct dental services to 1,400 or more patients.[11] This type of setting can also provide a full spectrum of services from prevention (e.g. prophylaxis, sealants and fluoride) to treatment services (e.g. fillings, implants and oral surgery procedures). Mobile and portable dental programs operate as a safety–net for individuals or groups that do not have a dental home. These types of programs are often administered by agencies such as the Department of Public Health, dental/dental hygiene schools, neighborhood health centers, non–profit organizations and individual volunteers, thus the term "public health settings."

With the expanding scope of practice for the dental hygienist in a public health setting, these programs are moving beyond the traditional community–based health centers with the use of mobile and portable dental equipment allowing services to be provided outside the confines of a fixed equipment facility. Recent developments in the technology and transportability of portable equipment (e.g. patient chair, unit, light and clinician chair) have allowed dental personnel to administer screenings, prevention, education and treatment to patients outside a traditional fixed dental office setting.[11] For portable equipment to be effective, it must be easily transported, have sound durability, good ergonomical features and be able to sustain the required infection control recommendations for dental settings.[11]

The CDC issued updated guidelines for infection control and disease prevention in 2003. Although these guidelines focus mainly on outpatient, ambulatory dental settings, the recommended infection–control practices are applicable to all settings in which dental treatment is provided.[1] Literature suggests that several factors have been related to infection control standards in the clinical dental setting using fixed equipment.[1,12,13] To date, no studies have evaluated the current practices and challenges to implementing proper infection control in settings that use portable equipment. With an increase in dental public health programs using portable equipment, current CDC infection control guidelines may impact these settings and require further guidance to ensure the safe delivery of dental care for providers and patients. This study attempted to address this question and set the foundation for future research in this area.

Methods and Materials

Instrument

An expert panel of 9 health care professionals, consisting of dental public health program directors, clinicians and an epidemiologist convened at the Forsyth Institute in Boston, Massachusetts in 2007 to discuss the topic of infection control in public health settings using portable or mobile dental equipment. The group identified the following infection control challenges that are faced when providing care in community and school–based settings: space limitations for providing care, lack of hand washing sinks in immediate care area, insufficient instrument processing area, storage of contaminated items, sharps management and challenges with waste management (handling storage and disposal). A 38 item forced–choice questionnaire evaluated by the panel was used to elicit information on site characteristics, infection control policies and procedures and infection control behaviors. Face validity of the questionnaire was determined based on their responses and modifications were made to insure that items were applicable for public health settings. The questionnaire was again tested for face validity with 2 dental public health care providers from the Forsyth Institute. The finalized questionnaire–based survey consisted of 26 open and closed ended and Likert scale questions designed to elicit information on the current infection control practices used in Massachusetts dental public health programs and assess the perceived compliance and challenges with infection control standards as outlined in the 2003 CDC guidelines. The University of Missouri–Kansas City Social and Behavioral Sciences Institutional Review Board approved this survey prior to administration.

Data collection procedures and statistical analysis

Due to the preliminary nature of this investigation, a convenience sample of dental public health programs in the state of Massachusetts was utilized in the fall of 2009. A database of active email addresses of program directors (n=82) was identified through the Massachusetts Department of Public Health (MDPH), Massachusetts League of Community Health Centers and local dental and dental hygiene schools. The electronic questionnaire–based survey was sent to all program directors via Survey Monkey. Non–responders were sent a second invitation to participate, 2 weeks following the initial mailing. Responses were blinded to ensure anonymity and confidentiality.

The coded data was obtained from the electronic survey program Survey Monkey and imported into and analyzed using the Statistical Package for Social Sciences (SPSS® Inc.,18.0). Factor analysis was used to assess 3 areas: infection control practices, perceived compliance to and challenges with the CDC 2003 infection control guidelines.

Results

Characteristics of the sample. Of the 82 program directors invited to participate, 35 returned the survey for a response rate of 43%. The demographics of the sample are represented in Table I. Worth noting, 74.3% of responders used fixed equipment compared to 17.1% who used portable equipment. A demographic summary of the sample consisted primarily of fixed settings located in community health centers in urban locations funded by both federal and state funds and supervised primarily by the Massachusetts Department of Public Health, which typically saw over 35 patients per day.

Practice Behaviors. Evaluation of the program directors' assessment of practice behaviors is depicted in Table II. Questions on the survey were related to infection control behaviors and methods specific to their practice setting, such as most frequent method of hand hygiene, most frequently used method of cleaning instruments prior to sterilization, aerosol and spatter control, surface disinfection and management of regulated waste. The study found that a majority of the programs had access to a sink, water and soap (42.9%), which was the most frequent response for hand hygiene followed by an alcohol–based hand rub (40.0%). Pre–cleaning of instruments was primarily accomplished by using an ultrasonic cleaner (48.6%). The most frequent method to control aerosol and spatter was by use of a saliva ejector (82.8%) followed by high speed evacuation (74.3%), and off–site disposal of medical waste accounted for the majority of the responses (42.9%).

Perceived compliance and challenges. A factor analysis of perceived compliance and challenges for infection control was performed and explained 85% of the values in the survey items (Table III). Norman et al suggests that correlations of r=0.70 and above indicate a strong relationship among the variables.[14] The 5 constructs/factors that were extracted included:

- (Construct 1) perceptions of guideline adherence

- (Construct 2) constraints to guideline adherence
- (Construct 3) negative view of CDC guidelines/barriers
- (Construct 4) attitude about low risk of infection
- (Construct 5) attitudes about guidelines for settings using portable equipment

Regarding the first construct (guideline adherence), there was a strong correlation (r=0.914) between guideline adherence and having access to the necessary supplies and equipment for implementing CDC infection control guidelines. Additionally, a very strong correlation existed in relation to the program directors' perceptions of their programs infection control policies and procedures compliance with the current CDC guidelines (r=0.954) as well as their perception that the CDC guidelines are effective for their practice setting. Concerning constraints of CDC guidelines adherence (Construct 2), a strong correlation (r=0.938) presented, indicating that it was perceived that if the CDC guidelines were not followed, it was because of financial constraints followed by lack of dental personnel (r=0.874). Construct 3 (negative view of CDC guidelines) showed a strong correlation (r=0.985) relating to the difficulty of applying the guidelines to their practice settings. Construct 4 (attitude about acquiring infection) indicated that there was a strong correlation (r=0.932) related to the directors' perception that there is a low risk of acquiring infection from the patients seen at their facility. The final construct that emerged from the perception part of the survey addressed whether additional infection control guidelines would be useful for public health settings using portable equipment indicating that a strong correlation (r=0.925) existed. Some items in this section of the questionnaire were not answered,

Table I: Demographics

Characteristics	Frequency	Percent
School	6	17.1
Community center	6	17.1
Community health center	21	60.0
Other	1	2.9
Urban location	19	54.3
Suburban location	4	11.4
Rural location	7	20.0
Uses fixed equipment	26	74.3
Uses portable equipment	6	17.1
Uses mobile equipment	3	8.6
Oversight by Massachusetts Department of Public Health	22	62.9
Oversight by dental/dental hygiene program	7	20.0
Oversight by research center	1	2.9
Oversight by "Other"	7	20.0
Funded by federal agency	23	65.7
Funded by state agency	21	60.0
Funded by private source	13	37.1
Funded by "other source"	3	8.6
Screening/examination services provided	30	85.7
Prevention services provided	30	85.7
Treatment services provided	26	74.3
# of patients seen in a typical day (20 or less)	4	11.4
# of patients seen in a typical day (21–35)	8	22.9
# of patients seen in a typical day (over 35)	16	45.7
# of personnel (5 or less)	5	14.3
# of personnel (6–11)	8	22.9
# of personnel (12–24)	12	34.2
# of personnel (greater than 25)	2	5.7

causing the final results not to be representative of the entire sample. Detailed responses to these constraints from program directors are shown in Table IV.

Limitations. The lack of a directory that identified settings using portable equipment in Massachusetts at the time this study was being conducted resulted in convenience sample recruitment. The sample size of portable equipment users was low (n=6). Therefore, significant conclusions cannot be extrapolated from the results for these settings. Another possible limitation was that the results were self reported by the program directors raising the question of bias on some of the responses, e.g. failure to admit that their program does not adhere to the CDC guidelines or that they are familiar with the guidelines.

Discussion

This pilot study attempted to capture the infection control behaviors, challenges and perceptions of public health program directors in dental public health settings in Massachusetts. With an increase in the number of programs and providers, including dental hygienists delivering care to underserved populations in the state and throughout the country, the question could be asked if there are any barriers or challenges for implementing the current CDC infection control guidelines for these settings and in particular, programs that use portable equipment.

Practice behaviors demonstrated that hand hygiene with soap and water accounted for the most frequently used method of hand cleaning, which is the recommendation in the 2003 CDC guidelines.[1] The availability of sinks with water contributed to this adherence. Programs that only provided screening/examination and prevention services and, therefore, did not have visibly soiled hands or were contaminated with blood or other potentially infectious material, could account for alcohol–based hand rub use which is the acceptable method of hand hygiene from the CDC when hands are not visibly soiled.[1] Instrument processing, including pre–cleaning and sterilization, did not present significant barriers for the majority of programs. This finding is not surprising since public health settings using fixed equipment have similar physical characteristics and properties of a traditional fixed dental facility. As a result, they do not present the same challenges that settings using portable equipment may encounter such as lack of electricity or limited physical space when housed in hallways, basements or small rooms in public buildings. The CDC guidelines recommend separate areas for processing clean and dirty instruments and the use of an automated cleaning device (e.g. ultrasonic cleaner or dishwasher/disinfector) for pre–cleaning of instruments.[1] The directors of programs located in fixed settings indicated compliance with this recommendation with limited or no challenges. Waste that is infectious and may cause substantial risk with handling and

Table II: Practice behaviors

Practice methods	Frequency	Percent
Hand washing soap/water	15	42.9
Antiseptic handwash	2	5.7
Alcohol–based handrub	14	40.0
Pre–cleaning of dirty instruments – hand scrubbing	4	11.4
Pre–cleaning of dirty instruments – ultrasonic cleaner	17	48.6
Pre–cleaning of dirty instruments – dishwasher/disinfector	5	14.3
Method used for aerosol/splatter control – high speed evacuation	26	74.3
Method used for aerosol/splatter control – saliva ejector	29	82.8
Method used for aerosol/splatter control – rubber dam	21	60.0
Use of disinfectant sprays for surface disinfection	19	54.3
Use of disinfectant wipes for surface disinfection	29	82.9
Medical waste disposal on site	8	22.9
Medical waste disposal off site	15	42.9
Medical waste disposal both on and off site	1	2.9

disposing of is considered regulated medical waste (e.g. cotton rolls and gauze saturated in blood and/or saliva, extracted teeth, surgical removal of hard or soft tissues and sharp items such as anesthetic needles, surgical blades, orthodontic wires, broken metal instruments and burs). Programs that only provide screening/examination services do not generate medical waste, therefore can dispose waste with ordinary waste. The same applies to prevention programs (sealants/fluoride) if cotton rolls and gauze are not saturated in saliva. A regulated medical waste service or incineration was not applicable and was not utilized.

The factor analysis did provide strong correlations regarding the program directors' beliefs that their sites had access to the necessary supplies and equipment for waste management, had access to sinks and products necessary to perform hand hygiene and had access to the necessary personal protective equipment as recommended in the CDC guidelines. These findings suggest a possible correlation exists between funding and availability of supplies necessary for proper infection control procedures as recommended in the 2003 CDC guidelines. The program directors' perceptions of barriers to guideline adherence were strongly related to factors such as limited finances, personnel and space constraints. This is significant in that the programs are able to ap-

Table III: Program directors group factor analysis of items measuring perceptions of practice behaviors, compliance and challenges regarding infection control

Factor	Factor Loading
Factor 1 (perceptions of guideline adherence)	
• The site has access to the necessary supplies/equipment for implementing proper waste management according to CDC guidelines.	0.914
• The site has access to sinks and products necessary to perform hand hygiene as recommended by the CDC guidelines.	0.745
• The site has access to the necessary personal protective equipment (PPE) as recommended in CDC guidelines.	0.707
• The infection control policies and procedures of our program comply with current CDC guidelines.	0.954
• I know where to obtain information about CDC guidelines.	0.707
• CDC guidelines are effective for our practice setting.	0.877
Factor 2 (constraints to guideline adherence)	
• If CDC guidelines are not followed, it is because there is lack of dental personnel.	0.874
• If CDC guidelines are not followed, it is because of space constraints.	0.763
• If CDC guidelines are not followed, it is because of financial constraints.	0.938
Factor 3 (negative view of CDC guidelines: barriers)	
• If CDC guidelines are not followed, it is because of space constraints.	0.908
• CDC guidelines are hard to apply.	0.895
Factor 4 (attitude about low risk of infection)	
• There is a low risk of acquiring infection from the patients seen at this facility.	0.932
Factor 5 (attitudes about guidelines for settings using portable equipment)	
• Infection control guidelines specific to settings using portable equipment would be useful.	0.925

Table IV: Frequency distribution of survey item responses to CDC guidelines

Survey Item	Frequency							
	Strongly Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Strongly Disagree	Don't know	Total	Missing
If CDC guidelines are not followed, it is because of lack of dental personnel.	–	–	3+	1+	23 (5* 18+)	3+	35	5
If CDC guidelines are not followed, it is because of financial constraints.	–	1+	3+	5+	19 (5* 14+)	2+	35	5
If CDC guidelines are not followed, it is because of space constraints.	–	1+	3+	4 (1* 3+)	20 (6* 14+)	2+	35	5
CDC guidelines are hard to apply.	31 (4* 27+)	–	–	–	–	–	35	4
Infection control guidelines specific to settings using portable equipment would be useful.	25 (4* 21+)	–	–	6+	–	–	35	4

Key:
* = using portable equipment
+ = using fixed/mobile equipment

ply the CDC guidelines to their practice settings, but feel that when barriers occur, the size of the work environment, the number of personnel in addition to the ability to pay for the necessary supplies and equipment all present challenges for implementation and guideline adherence.

Conclusion

Within the limitations of the sample size and response rate, directors from public health settings using either fixed/mobile or portable equipment reported being able to apply the current 2003 CDC infection control guidelines with few compliance challenges. However, regardless of the type of practice setting, the respondents indicated that the guidelines were hard to apply and that infection control guidelines for settings using portable equipment would be useful. This may require future consideration and guidance especially with an increase number of dental public health programs utilizing portable equipment to address the issue of access to dental care.

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