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Features

Guest Editorial

Defining the Dental Hygienist's Role in Improving Population Health through Interprofessional Collaboration

Jessica L. Parker, MS, RDH and Maria C. Dolce, PhD, RN

The shifting landscape of the United States (U.S.) health care system presents vast opportunities for dental hygienists to advance their role in improving population health. In recent years, public and private funders have contributed significantly to support the development and testing of new health care delivery models that expand boundaries across all health professions. National, state, and local foundations have invested more than $5 million to advance oral health in America, including the development of innovative oral health care delivery models.[1] In 2014, the U.S. Department of Health and Human Services awarded more than $665 million to emerging state-led, health care delivery models aimed at improving the quality of health care delivery and lowering health care costs.[2] Integrated care models offer promising pathways for practicing and future dental hygienists to define their role in collaborative practice to improve population health.

At the Harvard School of Dental Medicine, researchers are testing *the Nurse Practitioner-Dentist (NPD) Model for Primary Care,* a novel collaborative practice model to improve access to primary care particularly for vulnerable, underserved older adult (aged 65 and older) dental patients without a usual source of medical care. The NPD Model is a three-year cooperative agreement funded by the US Health and Human Services, Health Resources and Services Administration, to support the development of a collaborative practice environment to improve patient and population-centered care. The specific aims of the NPD Model are to (a) increase access to primary care, and (b) improve chronic disease management for older adults living with diabetes and/or hypertension. The project began on July 1, 2015 and on February 1, 2016 integrated care teams began providing care to older adult dental patients at the Harvard Dental Center Teaching Practices. Population health outcome measures related to chronic disease management, behavioral factors (e.g., smoking and alcohol consumption, physical activity, diet) and physiological factors (e.g., blood pressure, body mass index, blood glucose, cholesterol)[3] are addressed and managed by the integrated care team. This model defines the role of the dental hygienist as an integral member of the primary care team who collaborates directly with the Nurse Practitioner (NP) to promote overall health and wellness. Responsibilities are within the dental hygienist's scope of practice, which includes: the health history assessment, collecting vitals, gathering information regarding the patient's medical conditions, diseases, and medications, and assessing how the patient's medical conditions impact dental care. Upon completion of the health history assessment, the dental hygienist determines if the patient has a usual source of medical care and makes an appropriate referral to the NP. If the patient has medical needs that require additional consultation or if the dental hygienist has unanswered health questions or concerns a chairside consult with the NP is made. The NP is responsible for overseeing the clinical challenges associated with primary care and chronic disease management and implementing preventive primary care services for populations. Together with the patient, the dental hygienist and NP are able to create an interdisciplinary plan of care that addresses the patient's oral health and overall health care needs. Additional education and training for dental hygienists is not required in this integrated model, and thereby avoids the challenges associated with the advancement of dental therapists and/or advanced dental hygiene practitioners. In 2018, an implementation guide, including program outcomes, will be shared with interprofessional professional associations and academic health sciences centers to support the replication of the NPD Model.

Emerging collaborative practice models present opportunities for dental hygiene educators. Clinical experiences engaging dental hygienists and other health care professional students and providers, demonstrates compliance with dental hygiene accreditation standards and advances interprofessional education competencies. Such practice-based learning experiences enrich the dental hygiene curriculum by teaching students about the roles of other health

care providers, thereby broadening their capacity to serve as leaders of interprofessional care teams upon entering the workforce. Moreover, such curricular innovations reflect the changes occurring in the U.S. health care system and help meet an important goal of the Triple Aim: improve population health.[4]

Dental hygienists are well positioned to improve population health and address the oral health and general health care needs of patients and populations. The dental hygienist is appropriately educated and trained to address oral-systemic health and collaborate with other health care professionals. Therefore, from a practice perspective, dental hygienists are well prepared to collaborate with the NP to ensure care coordination and delivery of primary care services within dental settings. Such partnerships are integral to improving population health and establishing the role of the dental hygienist in emerging integrated care teams.

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Interprofessional Education in Dental Hygiene Programs and CODA Standards: Dental Hygiene Program Directors' Perspectives

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Abstract

Purpose: The Patient Protection and Affordable Care Act changed the paradigm of health care delivery by addressing interprofessional education (IPE) and care (IPC). These considerations, combined with evolving dental hygiene (DH) workforce models, challenge DH educators and clinicians alike to embrace IPE and IPC. The objectives of this study were to determine DH program directors' perceptions of the importance of IPE, to assess current and planned activities related to Commission on Dental Accreditation (CODA) standards that imply competency in IPE, and assessment of outcomes.

Methods: Email addresses of the 322 entry-level, DH program directors in the United States were obtained from the American Dental Hygienists' Association and a web-based survey was developed based on the American Dental Education Association Team Study Group on Interprofessional Education. Descriptive statistics were computed for the responses to the closed ended questions and answers to open-ended questions were transcribed and thematically coded.

Results: A response rate of 30% (N = 102) was obtained from the DH program directors. While the respondents indicated that they personally considered IPE to be important, one-third reported that IPE was not a priority for their academic institution. The majority of current IPE activities related to the 2014 CODA Standards 2-17, 2-26 and 2-19 were clinic-based (Standards 2-17 and 2-19: N=49; Standard 2-19: N=64). Fewer classroom-based activities were reported (N=12 vs. N=25). The respondents planned 27 clinic-based, 9 classroom-based and 51 other future IPE-related activities. Competency assessment was mostly determined with clinic-based activities (N=43) and other activities such as rubrics (N=16) and the development of IPE assessment tools (N=10). Thirty-three respondents named positive aspects of IPE and 13 saw IPE as relevant for the dental hygiene profession.

Conclusion: Accountable accreditation standards have been identified as the driver of change for incorporating IPE, making an explicit IPE standard for dental hygiene education an important agenda item for the profession.

Keywords: dental hygiene, accreditation, dental hygiene education, dental hygiene program, interprofessional education, interprofessional care

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Introduction

The Patient Protection and Affordable Care Act changed the paradigm of health care delivery in the U.S. by embracing interprofessional education (IPE) and interprofessional care (IPC), following the recommendations of the World Health Organization, the Institute of Medicine, and the Interprofessional Education Collaboration.[1,2] IPE has been defined as students from at least two disciplines having courses together either discretely or across the entire curriculum[3]. IPC in health care is the optimal provision of patient care because of the contributions of different areas of specialization and the use of evidence-based decision making[4,5]. This paradigm shift is significant for the dental hygiene profession because it stresses the importance of interprofessional team efforts in disease prevention and patient care.

IPE and IPC are meant to improve patient outcomes through coordinated care which includes shared input from various behavioral and health care disciplines[2,6]. Each discipline offers a unique perspective and expertise that may be overlooked by a single health care provider. Students therefore need to be educated to analyze information from a variety of health care perspectives in order to develop holistic, individual treatment plans.[7]

The Role of Dental Hygiene in IPC

Dental hygiene is well suited to contribute to IPC because its role is preventive in nature, with a

significant educational background in analyzing the impact of systemic conditions and medications on oral health. Dental hygienists also implement treatment plans and evaluate their outcomes, which is required in the Commission on Dental Accreditation (CODA) Accreditation Standards for Dental Hygiene Education Programs.[4,5] Three accreditation standards imply that dental hygienists should provide oral health care in a manner that is harmonious with patients' other health care needs through collaboration with other health care providers when necessary. Specifically, current CODA Standard 2-13 refers to the dental hygiene process of care (DHPOC), including the collection of all medical and dental history data and the delivery of patient-centered care.[4] The collection of pertinent medical information can often lead to consultations with other health care providers in order to provide optimal, patient-centered care. This may mean interacting with a pharmacist to obtain information about specific medications, or a physician to discuss appropriate care based on particular medical conditions. Such communications are covered by current Standard 2-15 which specifically requires the dental hygiene graduate to be competent in effectively communicating with other members of the health care teams.[4] Competency in these two standards allows for the provision of the comprehensive patient care and management required in current Standard 2-23.[4]

Additionally, the opportunities for dental hygiene providers to contribute are increasing in community centers and other health care institutions due to the expansion of licensure scope into areas of less supervised settings.[8] The engagement of dental hygienists in IPC with medicine, and other behavioral and allied health disciplines for the delivery of oral health care in primary care settings has the potential to improve health outcomes for patients.[6] IPC can also lead to increased respect among the members of the various disciplines involved, a necessity for practice in the new health care paradigm.[9] Dental hygienists will need the appropriate education to effectively integrate into interdisciplinary health teams and be accepted as an important part of a preventive approach to patient care.[8]

Best Practices

While IPE is still a developing concept in dental education, some best practices have been identified.[3] Two common themes for best practice that have emerged for successful IPE ventures are structure and preparedness. Other best practices include: 1) a leader or co-leaders, 2) a full, continuous experience rather than a one-off course, 3) incorporation of student feedback, 4) a progressive immersion across the curriculum, and 5) administrative support.[3] Additionally, assessments can be used to evaluate student readiness for engagement, as well as the measure their IPE experience. The Readiness for Interprofessional Learning Scale (RIPLS)[10] is an instrument that can be used to measure student readiness for IPE[10], while the Interdisciplinary Education Perception Scale[11] can be used to measure outcomes post-IPE engagement as developed by Formicola et al., in 2012.[3]

Forming IPE partnerships has been found to help build opportunities to become part of such teams. These partnerships have been identified as a must for the paradigm shift needed in dental and dental hygiene education. Wilder et al. reported that regardless of whether engagement is achieved through inclusion in previously developed IPE programs, establishing IPE initiatives within the individual institutions, or forming partnerships with community stakeholders, the lack of opportunities must be overcome.[12] Additionally, Bennett, et al found that support from institutional administration at the dean level and above has been consistently identified as being imperative to the success of integrating IPE into curricula.[13]

Barriers

Barriers to IPE are not confined to dental hygiene, and have been found consistently in other disciplines across the literature. Barriers frequently include lack of understanding amongst health care disciplines about other disciplines[14], and the prospect of the need for significant allocation.[7] Lack of support from institutional administrators needed to address resistance to change by both faculty and staff, and the significant allocation of institutional resources to manage the details of these changes have been identified as major obstacles to implementing IPE.[13] These matters have been further complicated by the individual accreditation requirements for each discipline involved in an IPE program.[13]

IPE has become an explicit accreditation standard for the majority of health care disciplines. Zorek and Raehl reported the list of health disciplines with IPE as an educational accreditation requirement includes medicine, dentistry, baccalaureate and advanced nursing programs, physician assistant programs, occupational therapy, pharmacy, physical therapy, and public health.[1] While IPE has become an explicit requirement for dentistry, the vast majority of interprofessional efforts have been confined to medicine and other allied health care professions.[15]

This presents an even larger challenge for the dental hygiene profession because IPE is only implicitly mentioned in the CODA Accreditation Standards for Dental Hygiene Education Programs. The inclusion of IPE in the accreditation standards of health disciplines has been noted as an imperative mechanism for its successful integration.[1] Because curricula are often driven by accreditation standards, they they motivate change.[1] Therefore, the lack of accountable IPE standards may present a significant barrier to the incorporation of IPE into dental hygiene education. Results from a recent survey of dental hygiene program directors in the U.S. found that very few programs are engaging in IPE endeavors

Table I: Overview of the program characteristics of the responding dental hygiene programs

Program characteristics	Frequencies or: Mean	Percentages or: SD / Range
Educational setting where the undergraduate dental hygiene program is located:	**N**	**%**
- Community or junior college	55	54%
- University or 4-year college	16	16%
- Dental School	13	13%
- School of Allied Health Sciences	10	10%
- Technical college	7	7%
- For profit career college	1	1%
Type of degree granted:	**N**	**%**
- Associate degree	81	81%
- Baccalaureate degree	30	29%
- Diploma/certificate	3	3%
- Master's degree	3	3%
Program has:	**N**	**%**
- an undergraduate program only	93	81%
- an undergraduate and a graduate program	9	9%
Number of students that graduate per year from the undergraduate programs	**Mean** 24.92	**SD/Range** 10.515
Program length in number of months of the undergraduate programs	**Mean** 25.80	SD/**Range** 6.04 18.48

that can be defined as true IPE activities.[16] Therefore, central questions to be addressed should include the dental hygiene program's level of engagement in IPE, how the IPE engagement takes place, any challenges encountered with IPE, and whether the graduates are successfully prepared for IPC.

Given the implicit nature of the Accreditation Standards for Dental Hygiene Education Programs related to IPE, the objectives of this study were to determine (a) dental hygiene program directors' attitudes concerning the relevance of IPE, (b) current IPE activities as well as IPE activities planned for future implementation in the curriculum, and (c) the methods used to perform IPE-related outcomes assessments.

Methods and Materials

This study was determined to be exempt from Institutional Review Board (IRB) oversight by the IRB for the Behavioral and Health Sciences at the University of Michigan in Ann Arbor, MI (HUM#00083956). Recruitment emails were sent to the directors of the 322 entry-level dental hygiene programs in the United States. The program director emails were obtained from the American Dental Hygienists' Association website. The recruitment email contained a web link to an anonymous electronic survey adapted from a survey previously used by the American Dental Education Association (ADEA) Team Study Group on Interprofessional Education to investigate IPE activities in U.S. and Canadian dental schools.[3] An electronic, revised version of the survey used by the American Dental Education Association (ADEA) Team Study Group on Interprofessional Education, which had previously been used to investigate IPE activities in U.S. and Canadian dental schools[10] was sent to all program directors individually using University of Michigan lessons. Permission to adapt this survey was obtained from Dr. Allan J. Formicola, head of the ADEA Study Group.

Respondents were asked to consider the 2014 CODA Standards 2-17, 2-19, and 2-26, which were implicitly relevant to IPE[4,17] in relation to the questions: 1) which current IPE activities were included in their curricula, 2) which future IPE activities were planned, and 3) how outcomes were assessed. Figure 1 shows the 2014 and current CODA Standards for Dental Hygiene Education Programs.[4,17]

Statistical Analysis: SPSS (Version 21.0. IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.) was used to analyze the data. Descriptive statistics such as percentages and means were computed to provide an overview of the responses to the closed ended questions (see Table I and Figure 2). Answers to open-ended questions were transcribed and thematically coded by the authors. Major categories and subcategories were identified, inconsistencies between the coders discussed and resolved, and the frequencies of responses in each subcategory were determined.

Results

A response rate of 30% (N=102) was obtained. Table I provides an overview of the program characteristics of the 102 responding dental hygiene programs. The majority of responses were from directors of programs at community or 2-year colleges that granted an associate degree.

Figure 2 provides an overview of the reported importance of IPE

Figure 1: Overview of the CODA Standards of Interest

CODA Standards for Dental Hygiene Education Programs	Standard # prior to 2014[1]	Current Standard #	Comparable Standards for Predoctoral Dental Education
Providing the dental hygiene process of care which includes: a) Comprehensive collection of patient data to identify the physical and oral health status; d) Provision of patient-centered treatment and evidence-based care in a manner minimizing risk and optimizing oral health; f) Complete and accurate recording of all documentation relevant to patient care.	**Standard 2-17**	**Standard 2-13**	**2-23** At a minimum, graduates **must** be competent in providing oral health care within the scope of general dentistry, as defined by the school, including: a. patient assessment, diagnosis, comprehensive treatment planning, prognosis, and informed consent;
Graduates **must** be competent in interpersonal and communication skills to effectively interact with diverse population groups and other members of the health care team.	**Standard 2-19**	**Standard 2-15**	**2-19** Graduates **must** be competent in communicating and collaborating with other members of the health care team to facilitate the provision of health care.
Graduates **must** be competent in problem solving strategies related to comprehensive patient care and management of patients.	**Standard 2-26**	**Standard 2-23**	**2-9** Graduates **must** be competent in the use of critical thinking and problem-solving, including their use in the comprehensive care of patients, scientific inquiry and research methodology.

Legend: 1 CODA Standard numbers at the time of data collection differed from the current Standard numbers.

to the program directors themselves, their academic institution, and the dental hygiene profession in the U.S. While the majority reported IPE as important both personally (58%), and for the dental hygiene profession at large (57%), only 40% thought it was important for their academic institution.

Table II provides an overview of the open-ended responses concerning current and planned IPE activities related to the DH accreditation standards that imply interprofessional interactions. Current IPE activities were centrally connected to clinic-based activities (Current Standards 2-13 & 2-15: N=49/Current Standard 2-22: N=64) and to a lesser degree to classroom-based activities (N=12 vs. N=25, respectively). Specific clinical activities were: outside medical consults, consults with staff or volunteer dentists in the clinic (N=19), and the treatment of patients at enrichment sites or volunteer

Figure 2: Dental hygiene program directors' perceptions of the importance of IPE for themselves, their academic institution and the dental hygiene profession in the U.S.

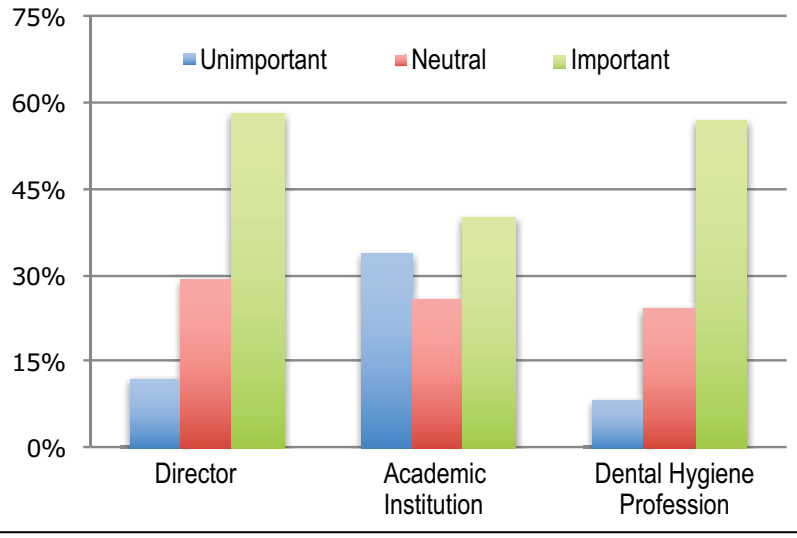

Table II: Frequencies of open-ended responses concerning the programs' **current** IPE activities and future IPE activities **in preparation** related to current CODA standards 2-13 & 2-22 and 2-15

Clinic-based activities:	Current activities related to current Standard			Future activities in preparation related to current Standard		
	2-13 & 2-22*	2-15	Total	2-13 & 2-22*	2-15	Total
Clinical activities	12	21	33	6	7	13
Contacting other health professions outside DH Clinic	7	15	22	0	0	0
Clinical interprofessional consults in clinic	11	8	19	0	0	0
Off campus clinical	5	7	12	0	0	0
Community-based activities & Service learning activities	8	2	10	1	5	6
Faculty Assessment	0	5	5	0	0	0
Collect patient data for each student	3	0	3	0	0	0
Simulation	0	3	3	2	1	3
Long or intermediate-term care facilities	1	1	2	0	0	0
Comprehensive care clinic	1	0	1	0	0	0
Group practice	1	0	1	0	0	0
Oral, written & computer skills in clinic	0	1	1	0	0	0
Student self-assessment	0	1	1	0	0	0
Enrichment/rotations	0	0	0	0	4	4
Objective standardized clinical examinations (OSCE)	0	0	0	1	0	1
TOTAL:	***49***	***64***	***113***	***10***	***17***	***27***
Classroom-based activities						
Research presentation	0	8	8	0	0	0
Classroom-based activities	3	3	6	0	0	0
Activities with other disciplines	0	5	5	0	0	0
Communications courses	0	4	4	0	2	2
Community courses	0	4	4	0	3	3
Case-based activities	3	0	3	4	0	4
Simulation	3	0	3	0	0	0
Week long health profession student orientation	2	0	2	0	0	0
CPR class	1	0	1	0	0	0
Diversity training	0	1	1	0	0	0
TOTAL:	***12***	***25***	***37***	***4***	***5***	***9***
Other activities						
IPE projects planned / investigated	0	0	0	18	19	37
Compliant	10	3	13	0	0	0
"Career" fair presentations	1	-	1	0	0	0
Portfolios	1	-	1	0	0	0
TOTAL:	***12***	***3***	***15***	***18***	***19***	***37***
No activities						
None / Not sure	12	6	18	19	15	34
In discussions with administration	1	1	2	0	0	0
TOTAL:	***13***	***7***	***20***	***19***	***15***	***34***

Legend: *See Figure 1 for an explanation of the CODA Standard numbers.

projects. Faculty assessment of student clinical performance, and collecting patient data for each student were also mentioned as clinic-based IPE activities. Classroom-based activities such as research pre-sentations and communication courses were relatively less frequently mentioned. When asked in which way their programs were preparing future IPE activities related to these standards, 37 programs reported planning mostly clinic-based IPE activities. Thirteen program directors simply stated they were compliant with the standards.

In regards to IPE outcomes assessment related to these CODA standards, faculty evaluation of students' clinical performance (N=25) was most frequently reported. The most commonly used outcomes assessment of classroom-based IPE activities were rubrics (N=16), and reflections (N=9). Over 20% of respondents reported they did not assess IPE-related efforts related to these standards, and 5% were unsure if they were assessed.

Program directors were asked about the challenges related to IPE they currently encounter, and those they expect to encounter in the future. Table IV provides an overview of the responses regarding these perceived barriers. Some of the top barriers reported were (a) curriculum overload (76%), (b) faculty calibration (48%), and (c) outcomes assessments (32%). Open-ended responses raised concerns such as inexperienced faculty, the newness of IPE, gaps in the literature, and lack of cooperation from other disciplines.

DISCUSSION

IPE is likely to become an imperative part of dental hygiene education in the future. This is largely due to the expanding scope of practice of dental hygienists in evolving new workforce models, and the new health care delivery system paradigm which has increasingly focused on prevention, coordinated care, and health outcomes. Given this expected trajectory, it is encouraging that the majority of the dental hygiene program directors in this study embraced IPE as important for themselves and the dental hygiene profession in the U.S. at large. A relatively lower percentage of respondents reported that IPE was also considered important by their institutional administration. This may explain why IPE is still not represented in all dental hygiene programs.[16]

Impact of Accreditation Standards

A major contributor to this underrepresentation is the fact that IPE is not explicitly mentioned in the current CODA Accreditation Standards for Dental Hygiene Education Programs (see Figure 1). Standards 2-13, 2-15, and 2-23 all have implications for IPC, in that they require the comprehensive collection of patient information. Standard 2-15 requires graduates to be competent in interpersonal and communication skills for interactions with *other members of the health care team*.[4] A comparison of the standards for dental hygiene education with predoctoral dental education shows a clear parallelism. However, the predoctoral dental education standards explicitly require IPE. Dental Standard 1-9 states, "The dental school must [sic] show evidence of interaction with other components of the higher education, health care education and/or health care delivery systems."[18] This is a direct statement that requires accountability in accreditation reporting. The parallel standards dental and dental hygiene education share have been noted in the literature as having implications for IPE[1], making it seemingly important for dental hygiene educators to embrace IPE.

Dental hygiene educators must understand the definition of IPE, and the implications within the accreditation standards. This study demonstrated that the implicit nature of IPE in the dental hygiene education standards is not recognized. Responses to the (a) current IPE activities, (b) planned IPE activities, and (c) outcomes assessments of the IPE activities that were reported by the dental hygiene directors as related to these three standards highlighted this lack of understanding. The majority of activities reported were not true IPE activities. True IPE activities incorporate shared work in clinical patient care, and are embedded across the curriculum.[19]

In regards to assessing outcomes related to Standards 2-13, 2-22 and 2-15, respondents felt that they were compliant with these standards in general, but their responses were not necessarily tied to assessing IPE-related outcomes in this context. While 17% reported they have not assessed IPE efforts from the perspective of these standards, others reported chart audits, classroom participation grades, and National Board Dental Hygiene Examination scores as outcomes assessments for IPE. This reiterates the importance of the need for an explicit IPE standard.

Barriers and Solutions

Table IV notes the specific barriers reported by program directors, which are consistent with those found in the literature. Time is invariably one of the largest challenges noted across disciplines. This has notably included lack of understanding by other health care disciplines, which has continued to be a barrier to establishing engagement in interdisciplinary education.[14] Lack of proactive measures on the part of administrators needed to address resistance to change by both faculty and staff, and the significant allocation of institutional resources to manage the details of these changes have been identified as major obstacles to implementing IPE in the literature.[13] Understanding of these barriers must be complemented with an understanding of best practices.

Support from institutional administration is a key component in the successful integration of IPE.[13] Failure to have equal support across administrative units weakens any IPE initiative from the start. Integration and curriculum overhaul require the use

of valuable faculty and institutional resources that are frequently already overtaxed.

Lack of faculty understanding and calibration is also a significant barrier to successful integration of IPE.[14] This is a new and emerging field in dental hygiene, requiring education of the educator. IPE is a culture change, and must therefore be handled accordingly. Best practices indicate that faculty involved in interdisciplinary education must have a clear understanding of the different roles of the other disciplines involved to maximize the educational experience.[14] In addition, faculty must feel like invested stakeholders in IPE initiatives. It is imperative that institutions invest heavily in educating their faculty about all aspects of IPE, focusing particularly on the role faculty will play in this process.[12] Without the appropriate support and resources, attempts to implement a new interdisciplinary curriculum will be fraught with difficulties.[7]

Additionally, curriculum development must include measureable outcomes for students based on agreed upon benchmarks amongst the disciplines.[6] The assessment of outcomes is essential to any IPE initiative, but a large undertaking beyond student outcomes alone. Because IPE includes students, faculty, and patients, outcomes must be assessed for all participants involved in IPE activities.[20]

Finally, forming IPE partnerships has been found to help build opportunities to become part of such teams. These partnerships have been identified as a must for a paradigm shift in dental and dental hygiene education. Whether engagement is achieved through inclusion in already developed IPE programs, establishing IPE initiatives at their institution, or forming partnerships with community stake-holders, the lack of opportunities must be overcome.[12] Lack of engagement with other disciplines has frequently resulted in misconceptions regarding the education and scope of practice of other health professions.[21] These misconceptions have created hierarchies that are difficult barriers to surmount in creating IPE efforts as well as clinical practice.

This has often been the case for dental hygiene. Ateah et al. demonstrated negative perceptions of a particular discipline affect both the manner in which other professions engage with members of this discipline, and the professional identity of members of that particular discipline.[21] Therefore, the proactive addressing of individual discipline misconceptions is also a best practice.[17] Under-standing the scope of practice and education of students' own profession, as well as that of those they are engaging with, is an important tool for effective IPE.[19] The recognition of the importance of oral health to overall health is creating obvious and natural

Table III: Frequencies of open-ended responses concerning the programs' outcome assessment activities related to CODA standards 2-13 & 2-22 and 2-15

Clinic-based activities	2-13 & 2-22	2-15	Total
Faculty evaluation of students	12	13	25
Clinic	3	8	11
Student self-assessment	1	2	3
Community outreach/service learning	2	-	2
Chart audits	1	1	2
Consultations	1	-	1
Simulation	1	-	1
TOTAL:	***21***	***24***	***45***
Classroom-based activities			
Reflection exercises	2	7	9
Community course	-	3	3
Classroom work	-	2	2
Participation grade	2	-	2
TOTAL:	***4***	***12***	***16***
Other activities			
Rubrics	10	6	16
Developing IPE assessments	4	6	10
Compliant	3	3	6
Student surveys	2	4	6
Projects	3	2	5
Reflection exercises	2	-	2
National board scores	1	-	1
Web portfolio	-	1	1
TOTAL:	***25***	***22***	***47***
No activities			
Have not assessed	17	6	23
Do not know	2	3	5
Lack of oral health understanding hinders	1	-	1
TOTAL:	***20***	***9***	***29***

Legend: *See Figure 1 for an explanation of the CODA Standards

Table IV: Frequencies of responses concerning barriers to IPE

	Percentages
Open-Ended Responses Regarding Perceived Barriers to IPE	**Numbers of responses**
- Lack of experience	5
- IPE is a new concept / not well defined / lack of evidence	3
- Lack of support or value from institution/ college / program	2
- Difficulty securing other discipline cooperation / discipline silos	2
- Dental Hygiene not considered important in IPE efforts	1
- Fear	1
- Financial barriers	1
- Lack of tools to implement easily	1
- Limited opportunities to engage in IPE	1
- Logistics of making IPE a reality	1
- Not enough IPE within dentistry to reach out to other disciplines yet	1
- Students do not work with students outside of college	1
- Time / schedules a barrier	1
Total number of barriers:	***21***

interdisciplinary education and collaboration opportunities for dental hygiene education and practice.[8]

This study had several limitations. First, due to the self-reporting nature of survey instruments, bias can be introduced, limiting the validity of the findings. Second, the response rate is also somewhat low, representing around one-third of dental hygiene education programs. Additionally, respondents may have consisted of those who are most interested and engaged in IPE, making it difficult to generalize the findings.

In summary, the new paradigm of IPE is recognized as valuable to the future of dental hygiene by program directors. IPE is especially important for the dental hygiene profession given its changing scope of practice, within the evolving health care delivery system. Dental hygiene educators and their programs are well placed to collaborate with other health and social/behavioral disciplines, to include oral health in the primary care setting. Unfortunately, dental hygiene is notably absent from those health and social/behavioral professions with accountable accreditation standards for IPE. This is a significant barrier to engaging in the new health care paradigm that includes IPE. While this and other barriers are a reality, the body of evidence to support IPE, and best practices for its implementation continues to grow. Dental hygiene educators and the profession in general must understand the true definition of IPE and IPC, barriers, and best practices of IPE in order to engage in IPC. While best practices are key to the successful implementation of IPE, accreditation standards have been solidly noted as the driver of change in the incorporation of IPE into already existing health education curricula. Therefore, the explicit requirement of IPE in CODA dental hygiene standards must become an agenda item in order for dental hygiene to stay consistent with other health and social/behavioral professions.

Conclusions

The majority of dental hygiene program directors in the U.S. consider IPE as important for themselves and the dental hygiene community at large. However, only about 40% responded that their own academic institution considers IPE as important. Given that dental hygiene CODA Standards do not explicitly include IPE, it is not surprising that not all programs engage in genuine IPE efforts or plan to include IPE activities in the future. In addition, IPE related outcomes assessments are also not performed in all programs.

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Effects of Yoga on Musculoskeletal Pain

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Abstract

Purpose: Musculoskeletal pain has been associated with work stress and a shortened career in the dental hygiene profession. The purpose of this study was to determine if participating in two yoga sessions per week would reduce the musculoskeletal pain reported by dental hygiene students and or impact body composition.

Methods: A convenience sample of 77 dental hygiene students self-selected into treatment (yoga) and control groups. Students in the yoga group participated in bi-weekly, 60-minute yoga sessions for 13 consecutive weeks. Students completed a questionnaire and a Comparative Pain Scale evaluation prior to and immediately following the study period to assess musculoskeletal pain. Additionally, the Omron HBF-514C Full Body Composition Sensing Monitor and Scale was used to measure body mass index (BMI), body fat, and muscle prior to and upon completion of the study. Paired sample t-tests and independent t-tests were used to analyze the data.

Results: Thirty-eight dental hygiene students, with an average age of 23.9 years, participated in the yoga group and 39 were assigned to the control group. The majority of the participants were Caucasian (63.6%) females (90.9%). Participants in both groups were of similar age, ethnicity, and had comparable pre-study Harich Comparative Pain Scale scores. After participating in the yoga sessions, the treatment group reported a significant decrease in musculoskeletal pain ($p<0.001$), while the control group reported no significant decrease in musculoskeletal pain ($p=0.881$). The yoga sessions did not significantly impact the BMI scores for the yoga treatment group ($p=.984$) or the control group ($p=.901$).

Conclusion: This research supports the practice of bi-weekly yoga sessions as beneficial in decreasing musculoskeletal pain in dental hygiene students. Yoga can be considered a viable complementary health approach to incorporate into student schedules as a means of increasing the health and longevity of a dental hygiene career.

Keywords: ergonomics, chronic musculoskeletal pain, complementary health, yoga, dental hygienists, dental hygiene students

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Introduction

Chronic musculoskeletal pain (CMSP) has been reported in numerous studies among practicing dental hygienists and dental hygiene students.[1-8] The most common areas of reported pain include: neck, shoulder, upper and lower back, and wrist/hand.[1-8] Causes of pain include: neck bending and twisting, repetitive motion, vibration, and static reach/grip.[5] Many dental hygienists have reported reducing the number of hours they work, taking time off, considered changing careers,[3,4,8] and have even left the profession entirely as a result of pain[4]. Dental hygienists have also reported needing assistance from other staff members and have been unable to finish patient treatment due to the pain in the workplace.[4]

Complementary Health Approaches to Reduce Pain

Utilization of Complementary Health Approaches (CHA) has increased in recent years, 2002 to 2012, in the general population.[9] Examples of CHA include: acupuncture, Ayurveda, chiropractic care, non-vitamin/non-mineral dietary supplements, massage, meditation, and yoga.[9] Dental hygienists have reported using CHA, including yoga, to manage and reduce their work-related pain. Dental hygienists who used CHA had higher career satisfaction, increased career longevity, improved overall health and well-being, and were able to work their desired number of hours.[4] The prevalence of CMSP in dentists who regularly practiced yoga was reported to be less when compared to those who participated in other types of physical activity.[10] The incidence of CMSP in

dental hygiene students who practice yoga has not been reported in the literature.

Effects of Yoga on CMSP

Yoga is described as a combination of breathing exercises, physical postures, and meditation used to calm the nervous system and balance the body, mind, and spirit.[9] Over 36 million Americans have reported practicing yoga in order to increase their flexibility, reduce stress, and to become more physically fit. Over 70% of yoga practitioners are women attending at least one class per week.[11] Many yoga practitioners believe that yoga improves performance with other activities, and in gerneral feel that practicing it is beneficial for overall well-being. Yoga practitioners have reported improved balance, and greater physical and mental strength when compared to non-practitioners.[11]

Yoga studies have been conducted among the general population suffering from chronic neck pain. Studies have shown a significant reduction in neck pain when yoga was practiced at least once a week for 90 minutes at a minimum of 9 weeks. Individuals with neck pain were also asked to continue their yoga practice at home between sessions in order to enhance the benefits.[12,13] Individuals who practiced yoga reported a higher body awareness, felt more relaxed, reduced their pain medications, and felt their lives had improved due a reduction in neck pain.[13]

In multiple yoga studies conducted in the general population with chronic low back pain, significant reductions in pain have been reported.[14-22] Yoga has been shown to improve strength, flexibility, balance, and posture in the general population.[17,20,22] In addition to pain reduction, the practice of yoga has also been shown to reduce stress, depression, and improve mental well-being.[14,15,20,21] Most studies show a significant reduction in back pain when yoga is practiced at least once a week[14-19] for a minimum of four weeks.[14] Sustained improvement in back pain has been reported from a period of six months[14,18] to as long as 12 months.[19]

CMSP is frequently reported by practicing dental hygienists and dental hygiene students.[1-8] CMSP has caused dental hygienists to reduce the number of hours they work[3,4,8] and even leave the profession.[4] Research shows that pain can begin early while still in dental hygiene school.[1,2,5-7] Dental hygienists have reported practicing yoga to reduce and manage their pain,[4] and yoga has been shown to reduce pain among the general population.[12-22] The purpose of this study was to determine if participating in two yoga sessions per week would impact the musculoskeletal pain reported by dental hygiene students and, or, impact body composition.

Methods and Materials

Dental hygiene students enrolled in two universities, Minnesota State University, Mankato, Minnesota and West Coast University, Anaheim, California, participated in this study. Human subject approval was obtained from the respective Institutional Review Boards, and informed consent was obtained from all participants. A convenience sample of 83 students participated in this study, however, six participants were omitted during the data analysis due to incomplete survey responses, resulting in a sample size of 77 students (N=77).

Participation in this 13-week study was voluntary and students could withdraw at any time. Data was collected over a two-year period, with 35 participants in year one, and 47 participants in year two. Students volunteered to participate in two Vinyasa flow yoga sessions per week, for one hour per session, and were assigned to the test group (n=38), the remaining participants were assigned to the control group (n=39). Both groups were instructed to continue their normal routines regarding physical activity.

Data Collection

The students completed a survey that included a self-reported pain level prior to and immediately following the study to assess perceived musculo-skeletal pain. The Harich Comparative Pain Scale, which combines pain level numbers of 0-10 with words and descriptions, was chosen in an effort to calibrate responses while maintaining brevity of the questionnaire. (Figure 1)

In order to examine the effect of yoga on body composition, heights were recorded for each participant, and the Omron HBF-514C Full Body Composition Sensing Monitor and Scale was used to measure weight, body mass index (BMI), body fat, and muscle prior to and upon completion of the study. Researchers have found measurements with the Omron scale to significantly correlate with BOD POD®, body composition results, (r=.95), albeit an overestimation of body fat.[23] Paired sample t-tests and independent t-tests were used to analyze the quantitative data. A p-value <0.05 was used to determine statistical significant differences between the two groups.

Results

Demographics

Participants (N=77) ranged in age from 19 to 37 years, with an average age of 23.9 years. The majority of the participants were Caucasian (63.6%) females (90.9%).Table I includes the specific breakdown for race/ethnicity. Eighty-seven percent of participants were in their 1st year of dental hygiene. Of the 77 participants, 36 resided in Minnesota and 41 resided in California.

Frequency of Musculoskeletal Pain

A majority (92.2%) of all the participants reported having experienced musculoskeletal pain since beginning the dental hygiene program. Over half (55.8%) of all participants were experiencing musculoskeletal pain once a week or more and 51.9% of the participants reported experiencing more

Figure 1 Harich comparative pain scale

	0 **No pain**	No pain. Feeling perfectly normal.
Minor Does not interfere with most activities. Able to adapt to pain psychologically and with medication or devices such as cushions.	**1** **Very Mild**	Very light barely noticeable pain, like a mosquito bite. Most of the time you never think about the pain.
	2 **Discomforting**	Minor pain, like lightly pinching the fold of skin between the thumb and first finger with the other hand, using the fingernails. Note that people react differently to this self-test.
	3 **Tolerable**	Very noticeable pain, like an accidental cut, a blow to the nose causing a bloody nose, or a doctor giving you an injection. The pain is not so strong that you cannot get used to it. Eventually, most of the time you don't notice the pain. You have *adapted* to it.
Moderate Interferes with many activities. Requires lifestyle changes but patient remains independent. Unable to adapt to pain.	**4** **Distressing**	Strong, deep pain, like an average toothache, the initial pain from a bee sting, or minor trauma to part of the body, such as stubbing your toe real hard. So strong you notice the pain all the time and *cannot completely adapt*. This pain level can be simulated by pinching the fold of skin between the thumb and first finger with the other hand, using the fingernails, and squeezing real hard. Note how the simulated pain is initially piercing but becomes dull after that.
	5 **Very Distressing**	Strong, deep, piercing pain, such as a sprained ankle when you stand on it wrong, or mild back pain. Not only do you notice the pain all the time, you are now so preoccupied with managing it that you normal lifestyle is curtailed. Temporary personality disorders are frequent.
	6 **Intense**	Strong, deep, piercing pain so strong it seems to partially dominate your senses, causing you to think somewhat unclearly. At this point you begin to have trouble holding a job or maintaining normal social relationships. Comparable to a bad non-migraine headache combined with several bee stings, or a bad back pain.
Severe Unable to engage in normal activities. Patient is disabled and unable to function independently.	**7** **Very Intense**	Same as 6 except the pain completely dominates your senses, causing you to think unclearly about half the time. At this point you are effectively disabled and frequently cannot live alone. Comparable to an average migraine headache.
	8 **Utterly Horrible**	Pain so intense you can no longer think clearly at all, and have often undergone severe personality change if the pain has been present for a long time. Suicide is frequently contemplated and sometimes tried. Comparable to childbirth or a real bad migraine headache.
	9 **Excruciating Unbearable**	Pain so intense you cannot tolerate it and demand pain killers or surgery, no matter what the side effects or risk. If this doesn't work, suicide is frequent since there is no more joy in life whatsoever. Comparable to throat cancer.
	10 **Unimaginable Unspeakable**	Pain so intense you will go unconscious shortly. Most people have never experienced this level of pain. Those who have suffered a severe accident, such as a crushed hand, and lost consciousness as a result of the pain and not blood loss, have experienced level 10.

Table I Race/ethnicity of participants (N=77)

	n	Percent
Caucasian	49	63.6
Asian	14	18.2
Hispanic	6	7.8
Multi-racial	2	2.6
African-American	1	1.3
Other	5	6.5

Table II: Frequency of current pain on pre-survey

	Musculoskeletal Pain (N=77)	Headaches/ Migraines (N=77)
Daily	5.2%	3.9%
5-6 times/week	5.2%	5.2%
3-4 times/week	18.1%	13.0%
1-2 times/week	27.3%	18.1%
1-3 times/month	36.4%	44.2%
Never	7.8%	15.6%

musculoskeletal pain as compared to before entry into the program (Table II).

At the time of the post-survey, 65.8% of participants in the yoga treatment group reported less musculoskeletal pain after participating in the study, compared to 7.7% of the control group. During the post-survey, 20.5% of participants in the control group reported more musculoskeletal pain as compared to only 2.5% of participants in the yoga treatment group. In separate questions specific to the yoga group, 71.8% felt their pain was somewhat to much better after participating in yoga, and 81.5% would participate in yoga again. In comparing yoga to previously used medication or other therapies to treat musculoskeletal pain, 57.9% of the treatment group preferred using yoga.

Frequency of Headaches/Migraines

Headaches or migraines are common with 84.4% all participants reported experiencing headaches or migraines since starting the dental hygiene program. Table II illustrates the headache/migraine frequency with 40.2% of all participants experiencing one or more episodes each week. Since starting the program, 46.1% of participants reported experiencing more headaches or migraines than before entering into the program. Similar to the reduction of musculoskeletal pain, 52.6% of participants in the yoga treatment group reported fewer headaches or migraines after participating in the study as compared to 7.7% of the control group.

Location of Pain

Participants identified current and previous levels of pain for various body areas, while also indicating if they have experienced pain during dental hygiene school (Table III). The most common areas of current pain reported on the pre-surveys include the lower back (40%) and the neck (37.7%), with the hip and upper arm/elbow the least commonly reported. The location of the pain experienced by students in the treatment and control groups, pre and post survey, is shown in Table IV.

In the yoga treatment group, there was a decrease in number of participants reporting current pain in the post-survey for all body areas with the exception of the shoulder and upper arm/elbow. For the control group, there was an increase in number of participants reporting current pain in the post-survey for all body areas except for the hip. Paired sample t-tests were used to compare the number of participants who reported current pain in each body area between the pre- and post-surveys. Significantly fewer participants in the yoga group reported current pain in the lower back after completion of the study as compared to the pre-surveys ($p<0.001$). No other significant differences were found in the yoga group. The only significant difference reported in the control group was an increased number of participants reported pain in the lower arm on the post-survey as compared to the pre-survey ($p=0.005$).

Table III: Reported pain by location, current and prior to entry into Dental Hygiene (DHYG) Program (N=77)

Location of Pain	Currently in Pain (no pain prior to DHYG) n (%)	Currently in Pain (also pain prior to DHYG) n (%)	Never had pain n (%)
Lower Back	17 (22.1%)	13 (16.9%)	18 (23.4%)
Neck	17 (22.1%)	12 (15.6%)	22 (28.6%)
Shoulder	8 (10.4%)	10 (13.0%)	34 (44.2%)
Upper Back	10 (13.0%)	6 (7.8%)	42 (54.5%)
Hand/Fingers	13 (16.9%)	1 (1.3%)	43 (55.8%)
Lower Arm/Wrist	6 (7.8%)	3 (3.9%)	50 (64.9%)
Hip	5 (6.5%)	2 (2.6%)	59 (76.6%)
Upper Arm/Elbow	2 (2.6%)	0 (0.0%)	67 (87.0%)

Table IV: Current pain specific to assigned group

Location of Pain	Yoga Group (n=38) n (%)	Control Group (n=39) n (%)	All participants (N=77) n (%)
Lower Back			
Pre-Survey	20 (52.6%)	10 (25.6%)	30 (40.0%)
Post-Survey	5 (13.2%)	14 (35.9%)	19 (24.7%)
Difference	-39.4%***	+10.3%	-4.9%
Neck			
Pre-Survey	15 (39.5%)	14 (35.9%)	29 (37.7%)
Post-Survey	10 (26.3%)	17 (43.6%)	27 (35.1%)
Difference	-13.2%	+7.7%	-2.6%
Shoulder			
Pre-Survey	10 (26.3%)	8 (20.5%)	18 (23.4%)
Post-Survey	12 (31.6%)	10 (25.6%)	22 (28.6%)
Difference	+5.3%	+5.1%	+5.2%
Upper Back			
Pre-Survey	11 (28.9%)	5 (12.8%)	16 (20.8%)
Post-Survey	7 (18.4%)	11 (28.2%)	18 (23.4%)
Difference	-10.5%	+15.4%	+2.6%
Hand/Fingers			
Pre-Survey	8 (21.1%)	6 (15.4%)	14 (18.2%)
Post-Survey	6 (15.8%)	11 (28.2%)	17 (22.1%)
Difference	-5.3%	+12.8%	+3.9%
Lower Arm/Wrist			
Pre-Survey	7 (18.4%)	2 (5.1%)	9 (11.7%)
Post-Survey	5 (13.2%)	11 (28.2%)	16 (20.1%)
Difference	-5.2%	+23.1%**	+8.4%
Hip			
Pre-Survey	5 (13.2%)	2 (5.1%)	7 (9.1%)
Post-Survey	2 (5.3%)	0 (0.0%)	2 (2.6%)
Difference	-7.9%	-2.6%	-6.5%
Upper Arm/Elbow			
Pre-Survey	1 (2.6%)	1 (2.6%)	2 (2.6%)
Post-Survey	3 (7.9%)	4 (10.3%)	7 (9.1%)
Difference	+5.3%	+7.7%	+6.5%

**Significance < .01; ***Significance <.001

Harich Comparative Pain Scale

In addition to reporting frequency and pain per body area, partici pants determined their overall level of musculoskeletal pain using the Harich Comparative Pain Scale. Pre-study participants (N=77) self-reported pain scores ranged from 0 to 5 (very distressing), with a mean score 1.88 (discomforting). Only 11.7% of the participants identified as having "no pain" on the Harich Comparative Pain Scale. Post-study participants (N=77) self-reported pain scores ranging from 0 to 5, with a mean score of 1.42 (between very mild and discomforting). Participants in the yoga group (n=38) and the control group (n=39) were similar in pre-study pain levels with no significant difference ($p = 0.175$) found using an independent t-test.

While both the treatment and control groups self-reported lower pain scores in the post-study as compared to pre-study surveys, a significant difference ($p < 0.001$) in scores was found using the paired sample t-test for the treatment group only (n=38). The paired sample t-test did not demonstrate a significant change in level of musculoskeletal pain reported before and after the research study (p=0.586) for the control group (n=39). Specific results from the paired sample t-tests are shown in Table V. In order to further examine pain reduction, paired sample t-tests were used a second time excluding any participants who reported a pain level of 0 in the pre-study survey. Again, a significantly lower self-reported pain score ($p < 0.001$) was found in the treatment group (n=33), and was not significant (p=0.128) in the control group (n=38).

Body Composition

Heights were recorded for each participant prior to and upon completion of the study. The Omron HBF-514C Full Body Composition Sensing Monitor and Scale was used to measure weight, body mass index (BMI), body fat percentage, and muscle percentage (N=77). Pre-BMI scores ranged from 17.1 to 43.5, with a mean BMI of 23.8. Pre-body fat scores ranged from 13.8% to 53.5%, with a mean of 33.1%. Pre-muscle percentage scores ranged from 21.1% to 44.2%, with a mean of 28.6%. Paired sample t-tests were used to examine any differences in BMI, muscle percentage, and body fat percentage. For the control group (n=39), no significant differences were found in BMI (p=0.901), muscle percentage (p=0.274) or body fat percentage (p=580). There were also no significant differences in the yoga group for BMI (p=0.984), muscle (p=0.201), or fat (p=0.566).

Table V: Comparison of Harich comparative pain scores pre- and post-survey

		Paired Differences				
	N	Mean	Std. Deviation	Std. Error Mean	T	Sig.
Yoga Group	38	0.842	1.285	0.208	4.041	<0.000***
Control Group	39	0.103	1.165	0.187	0.550	0.586

***Significance <.001

Discussion

CMSP has been reported by practicing dental hygienists and dental hygiene students,[1-8] and yoga has been shown to reduce chronic neck and low back pain among the general population.[12-22] CMSP is a concern for the dental hygiene profession as practitioners have reported reducing their work hours, taking time off, considered changing careers,[3,4,8] and have left the profession[4] due to chronic pain issues.

In this study, dental hygiene students reported pain most frequently in the lower back (40%) and neck (37.7%) which is similar to previous studies where dental hygiene students reported pain in the neck and lower back most often,[1,6] while practicing dental hygienists reported pain most frequently in the neck and shoulders.[2,4,7,8] More than half (55.8%) of the student participants in this study reported experiencing pain once a week or more, which is similar to previous research findings.[6,7] Most of the participants in this study who reported pain, were in their first year of the dental hygiene program (87.0%), which correlates with previous research.[1]

Dental hygiene students in the treatment group (65.8%) who practiced yoga twice a week for one hour per session reported significantly less pain when compared to the control group (7.7%). Likewise, dentists have reported less pain with a regular yoga practice.[10] These findings are similar to the general population who reported less pain with a weekly yoga practice for 90 minutes in duration.[12-22] The general population had a significant reduction in neck pain when yoga was practiced weekly for 9 weeks.[12] A significant reduction in back pain has been reported after 12 weeks of practicing yoga,[16,18,19,21] which is similar this study where dental hygiene students reported significantly less pain after 13 weeks.

Dental hygiene students reported increased pain (51.9%) since starting the program in this study, which is similar to previous research where students reported an increase in pain over a three-year span.[1] Practicing dental hygienists have reported that CHA are acceptable for pain management and as an alternative to conventional medicine[4] which is similar to these findings where dental hygiene students preferred yoga (57.9%) to treat their pain when compared to conventional medicine.

While this study primarily focused on musculoskeletal pain, information was collected regarding frequency of headaches and/or migraines, along with body composition. This study revealed that 40.2% of dental hygiene students are experiencing headaches/migraines at least 1-2 times each week. Headaches and migraines have a variety of predisposing factors including nutrition, changing sleep patterns, poor posture, stress, and secondary factors resulting from disease/illness.[24] This study suggests that yoga may be useful in reducing the frequency of headaches/migraines with 52.6% of participants in the yoga treatment group reporting fewer headaches or migraines following the study as compared to 7.7% of the control group.

No significant differences were found in body composition between the pre and post-study statistics for either group. Many factors influence body composition including nutrition, aerobic exercise and strength training. The authors are not suggesting that yoga is ineffective in changing body composition, however this study was not designed to incorporate nutrition and strength training which could have impacted body composition. More research is needed to determine how regular yoga practice might influence body composition as well as headaches/migraine frequency in dental hygienists.

One limitation to this study was that students were not asked to practice yoga outside of the twice weekly scheduled sessions, while previous studies asked participants to practice at home in addition to the weekly scheduled session.[12-16,18,19,22] Additional practice at home could have increased the amount of pain reduction. Another limitation was that the yoga instructors were not calibrated on the yoga poses taught to the students, although the particular style of yoga instruction was the same. Teaching a specific set of yoga poses may have created a different result. Yoga class attendance may have also influenced the overall amount of pain reduction. Some participants missed a weekly class session and were asked to make up the session at home with an assigned video. Having regularly scheduled make-up class with the instructor may have prevented the students from missing sessions during the study. In addition, a live class, as opposed to watching a video, is beneficial since the instructor is able to guide the participant into proper alignment and aids in injury prevention.

While yoga has been shown to reduce CMSP,[12-22] there are some contraindications to performing specific poses depending on the location of pain that has been frequently reported by dental hygienists.[1-8] Making the yoga instructor aware of previous injuries prior to the start of a class session is advisable so the instructor can guide the individualor modify the pose as needed.

Individuals with a back injury should avoid or modify the following poses: bow pose; camel pose; cobra pose; corpse pose; fish pose; and upward facing dog.[25] Individuals with a neck injury should avoid or modify: big toe pose; boat pose; bow pose; bridge pose; camel pose; cat pose; extended triangle pose; headstand; plow pose; and shoulder stand.[26] Individuals with a shoulder injury should avoid or modify: dolphin; dolphin plank; handstand; side plank; arm balancing poses; and any pose with the arms extended upward.[27] The following poses should be avoided or modified for individuals with carpal tunnel syndrome: cobra pose; crow pose; downward facing dog; plank pose; side plank pose; and upward facing dog.[28]

Future research should include studies on ergonomic and CSMP assessments in the clinical dental hygiene education setting and incorporation of yoga into the curriculum. Students could also be required to practice yoga independently, with hand-outs or videos, following the conclusion of formal class sessions with a follow-up assessment on prolonged pain reduction at six months post-study. This would be similar to previous studies assessing the long-term effects of a regular yoga practice six months following structured instruction sessions.[14,19,21] A follow-up questionnaire after one year in clinical practice would be beneficial to assess pain levels and determine if dental hygienists continued to practice yoga after the initial exposure to yoga in dental hygiene school.

Conclusion

This study found that CMSP starts during the first year of dental hygiene school, and practicing yoga twice a week significantly reduced pain in a dental hygiene student population. Proper ergonomics should be reinforced in the clinical setting to prevent pain from occurring, and may also prolong the effects of a regular yoga practice. Students should be aware that CMSP has important implications for career longevity and incorporating yoga into the dental hygiene curriculum should be considered. Practicing dental hygienists may also benefit from yoga practice as part of their daily lifestyle.

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RESEARCH

Student Preparation for the National Board Dental Hygiene Examination: A national survey of dental hygiene program directors

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Abstract

Purpose: Dental hygiene students nearing completion of their educational programs are required to take written and clinical examinations in order to be eligible for licensure. The written licensure exam, the National Board Dental Hygiene Examination (NBDHE), is administered by the Joint Commission of National Dental Examinations (JCNDE). Failing a licensing examination is a costly experience for students and has the potential for a negative impact on a program's accreditation status. Nursing programs have published extensively on strategies used to prepare students for licensure examinations. However, there appears to be a gap in the literature as to how dental hygiene programs prepare their students to take the NBDHE. The purpose of this study was to conduct a national survey of U.S. dental hygiene program directors to determine what strategies their programs employ to prepare students to take the NBDHE and to explore the viewpoints of dental hygiene program directors regarding student preparation methods for the NBDHE.

Methods: An survey instrument was developed, pilot tested, revised and mailed to directors of the 335 CODA accredited U.S. dental hygiene programs. The survey consisted of a combination of response formats including forced choice, multiple allowable answered, and open-ended written comments.

Results: A total of 154 surveys were returned, yielding an overall response rate of 45% (154/341). The vast majority of directors (93%) reported they use specific methods and practices to prepare students for the NBDHE. The top two strategies identified were dental hygiene review texts (84%) and a board review course (83%). The majority of directors (84%) reported supporting student participation in non-mandatory, commercial review courses. In regard to mock board exams, directors "agreed/strongly agreed" (75%) that the mock board exam is a useful coaching tool in the overall process of NBDHE preparations. A majority (65%) indicated they were not concerned with failure rates, and 43% reported failure rates do reflect on the program.

Conclusion: These results suggest that the majority of dental hygiene programs are utilizing strategies to prepare students for the NBDHE with board review textbooks and board review courses named as the top two strategies.

Keywords: dental hygiene education, dental hygiene students, National Board Dental Hygiene Examination (NBDHE), dental hygiene licensure, mock boards

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Introduction

Dental hygiene students nearing completion of their educational programs are required to take written and clinical examinations in order to be eligible for licensure. The written test, the National Board Dental Hygiene Examination (NBDHE), is administered by the Joint Commission on National Dental Examinations (JCNDE). Both the NBDHE and clinical tests are considered high-stakes examinations due to the fact that dental hygiene students must pass them to be eligible for licensure.[1] In 2012, the JCNDE reported a 4.2% failure rate among first-time NBDHE takers.[2] Students failing the NBDHE lose money in examination fees and time required to re-take the test. They also experience a loss of potential income as a result of being ineligible for licensure.

Additionally, dental hygiene program reputations are defined, in part, by student pass/fail rates on licensure examinations.[4] It is considered to be a universal goal for students to pass the NBDHE on the first attempt.[5] The Commission on Dental Accreditation (CODA) Standards for Dental Hygiene Education

Programs, Standard 1-Institutional Effectiveness, cites that the success of graduates on national boards can be evidence of a program's demonstration of effectiveness; one that utilizes a formal and ongoing planning and assessment process that can be systematically documented.[6] Hence, a poor class-wide pass rate could have a negative impact on a program's accreditation status. Conversely, student success on licensing examinations can be viewed as an indicator of program success, especially when considering the Commission on Dental Accreditation's (CODA) emphasis on outcomes-based education.[7]

A review of the health science literature reveals that nursing schools have published extensively on board preparation review strategies.[8-20] Nursing programs across the country use a wide variety of techniques to prepare students for the National Council Licensure Examination (NCLEX).[9,10,12,16-23] A national study to identify program requirements and educational interventions used to promote NCLEX-RN success identified the following nursing program interventions: academic referral (83 %, n = 132), commercial reviews (58 %, n = 91), social support referrals (57%, n = 91), computerized reviews (54%, n = 86), and faculty-led reviews (26%, n = 42).[10]

Dental education literature discusses preparation strategies for the National Board Dental Examinations (NBDE), Parts I and II. Researchers from the University of Texas Health Science Center at San Antonio (UTHSCSA) reported the use of mock board exams to prepare students for the national written board exam.[8] At UTHSCA, an 18 hour prep course was provided by content experts covering all aspects of the exam in addition to test taking strategies. However, when students were asked about preferred methods for preparing for the board exam, they indicated the commercial Dental Deck flashcards as their favorite review method. Similar findings were confirmed in a national study conducted by a third year dental student in 2009. [25] Over half of the dental students surveyed reported that while their institution provided some form of a written board review course, they favored Dental Decks as a primary source for preparing for the NBDE.[25]

Gadbury-Amyot et al. found that online NBDE Part I and Part II review courses were shown to be effective in assisting dental students to prepare for high stakes licensure examinations.[26] Innovative online courses, containing both synchronous and asynchronous components, allowed dental students to access asynchronous online study materials at their convenience, in addition to giving students the opportunity to interact with content expert faculty members during synchronous sessions. Study results showed that students used the online program to provide a structure for weekly preparation for the NBDE exams along with other forms of preparation that were similar to other study findings.[8,25]

Dental Hygiene Education and NBDHE Preparation Practices

A reported 6,882 students from over 330 dental hygiene programs in the United States took the NBDHE for a first attempt in 2012.[2] Despite the large number of dental hygiene students taking the NBDHE annually, very little research on how education programs prepare students for this high-stakes exam has been published in the literature. An Ovid Medline database search of the key word "NCLEX" in nursing produced 212 articles while a similar search using the key word "NBDHE" resulted in 11 citations.

A review of the existing literature supports that the most common strategy employed by dental hygiene programs to prepare students for taking the NBDHE has been the use of an institutional written mock dental hygiene board examination (MDHE).[1,7,27] Edenfeld and Henson examined the correlation between the NBDHE, MDHE scores, early course grade averages (ECA), and interim course grade averages (ICA).[7] They found that performance in courses taken by students prior to the mock board (ECA) was a better predictor of success on the NBDHE than the mock board exam itself.[7]

Gladstone et al. from New York University examined the effects of a required review course for preparing students for the NBDHE.[27] As a result of taking the required review course, students reported that they lowered their initial expectations of scoring 90% or above on the NBDHE and that they were better able to assess how much study was required in order to perform well on the national examination.[27] Students also reported that they valued the early review and assistance with setting a study schedule.[27]

In addition to institutional board review courses and mock board exams, the role of commercial board review courses in preparing students for the NBDHE has been investigated as a predictor variable in the literature.[28-30] Commercial board review courses have also been evaluated in regards to how students perceive them as a preparation strategy.[28-30] DeWald et al. compared students who took a particular commercial board review with students who did not take the course and found no significant difference in NBDHE performance between the two groups.[28] While higher scores as the result of taking a commercial board review course may not be supported by their study findings, DeWald et al. speculated that a commercial review course may help lower student stress by helping students feel more confident in their knowledge, more comfortable with the exam format and less anxious due to acquisition of study skills and preparation practices for written boards.[28]

In a 2006 poster presentation, Beatty evaluated dental hygiene alumnae perceptions of the value of a commercial board review as preparation for the NBDHE.[29-30] Alumnae of a dental hygiene program who had taken a commercial review course (n = 48) reported it as being somewhat to most beneficial

(98%). Beatty also reported that students used a variety of preparation methods including review of lecture notes, course textbooks, commercial review textbooks, previous examinations, and online resources and made the conclusion that commercial review courses have value, reinforce student learning, motivate students to study and present a plan of organized study. [29,30]

While the literature indicates that dental hygiene students utilize commercial board review courses as a NBDHE preparation strategy, there is a lack of research pertaining to the specific NBDHE preparation strategies specifically utilized by the dental hygiene education programs. The purpose of this quantitative study was to inform dental hygiene education programs on current NBDHE student preparation strategies by addressing the following questions:

What specific strategies are used to prepare students to take the NBDHE?

What are the views of the program director(s) regarding NBDHE preparation strategies?

Are there variations in NBDHE preparation strategies based on type of institution (Associate vs. Baccalaureate) or regional demographics?

Methods and Materials

The target population for this survey consisted of the program directors and co-directors (when applicable) of the 335 accredited dental hygiene programs in the United States as identified by the Commission on Dental Accreditation (CODA) on June 5, 2014.[31] Following approval by the Institutional Review Board at University of Missouri-Kansas City (IRB #14-307), an electronic database of 341 dental hygiene director and co-director names and mailing addresses was created for the survey and reminder communications.

Data Collection

A survey instrument, consisting of six sections and a total of twenty one questions, was developed based on a review of the literature and the use of content experts at the University of Missouri-Kansas City (UMKC). A preliminary pilot study was conducted with two associate degree and two baccalaureate degree dental hygiene programs. Feedback obtained from the pilot study was incorporated into the final version of the survey. Data collection, consisting of initial mailer, follow-up postcard, and two email reminders, took place over a two month period from October to December 2014.

Statistical Analysis

Descriptive data analyses consisted of frequency distributions, measures of central tendency, and tests of mean differences. Demographic data were compared with methods of board preparation to determine if an association existed. Independent variables were program demographics: degree granted at institution (associate versus baccalaureate) and the region of program location (Northeast, South, Midwest, and West). The dependent variables were the program directors' responses to preparation strategies used for the NBDHE. During statistical analysis, a decision was made to assign participants to specific groups according to responses. A one way ANOVA was performed to examine differences between NBDHE preparation strategies and program demographics. The level of statistical significance was .05 and the statistical analysis was performed using SPSS statistical package 22.0. Analysis of comments provided in the two open-ended questions were conducted following the principles of thematic analysis from Creswell, 1994 and Patton, 2002.

Results

A total of 154 surveys were returned, yielding an overall response rate of 45% (n=154). The largest percentage of respondents (36%) reported having served less than five years as program director; nearly 30% had served five to ten years. An associate degree was the most frequently reported degree granted (71%), followed by a baccalaureate degree (22%). "Community/junior college" was the largest percentage of program setting (52%), followed by "university/or college not affiliated with a dental school" (20%). Respondents were divided geographically into four regions, Northeast, South, Midwest, and West, with Alaska and Hawaii included in the West region. Institutions in the South and Midwest were the highest responders with 32% and 31% respectively (Table I).

To address the first research question, directors were asked if they use specific methods or practices to prepare their students for taking the NBDHE and the specific strategies employed. The vast majority (93%) reported they do use specific methods and practices with the top two strategies identified as dental hygiene review texts (e.g., Mosby, Saunders) (84%) and a board review course (83%). Board review courses included commercial (42%), institutional (18%), or both (23%). The majority of directors (84%) reported supporting student participation in non-mandated commercial review courses. Table II lists the various preparation strategies and resources reported by program directors for preparing their students for the NDHBE. Additional preparation strategies frequently reported included: previously released NBDHE questions (73%), a mock board examination (72%), strategies on how to study (69%), Dental Decks, practice questions, and test taking strategies (66%), and strategies for reducing anxiety (63%). Directors agreed/strongly agreed (75%) that the mock board exam is a useful coaching tool in the overall process of NBDHE preparations but were neutral (44%) on whether or not the mock board exam is accurate in predicting which students will pass the NBDHE. For programs who report that they conduct a board review, 26% award college credit with 37% of those employing

Table I: Descriptive and demographics data

Years as director	**N (%)**
Less than 5 years	56 (36%)
5 to 10 years	46 (30%)
11-20 years	28 (18%)
21 or more years	16 (10%)
Missing/Not applicable	8 (5%)
Degrees granted by institution	
Associate	110 (71%)
Baccalaureate	34 (22%)
Master's	10 (7%)
Dental Hygiene program setting	
Community/junior college	80 (52%)
University/or college NOT affiliated with a dental school	29 (20%)
Technical school/institute	15 (10%)
University/college affiliated with a dental school	16 (10%)
Vocational school/institute	7 (5%)
Other	6 (4%)
Academic medical center	1 (.6%)
Region Program is located in	
South	49 (32%)
Midwest	47 (31%)
West	30 (20%)
Northeast	26 (17%)

a mandatory attendance policy (Table III). The majority report that the review occurs in the spring semester (62%) of the final year. Sixty five percent of directors reported that instructors review and update board review resource material regularly and 21% of directors confirmed that the faculty receive guidance for writing board review test items. The relationship between NBDHE results and program completion was explored. In regard to the NBDHE as a graduation requirement, 86% of program directors reported that students are not required to pass the NBDHE in order to graduate. When asked how their programs predict student success on the NBDHE, the vast majority chose cumulative dental hygiene grade point average (GPA) (61%) followed by overall GPA (58%), and science GPA (50%) Forty four percent of the respondents indicated they have a formal process for identifying students at risk of not passing the NBDHE.

Research question two asked program directors about their views concerning preparation methods

Table II: Respondents' preparation methods and resources, both institutional and commercial, used for preparing students to take the National Board Dental Hygiene Examination (NBDHE)

Preparation method:	**N (%)**
Dental hygiene review texts (e.g., Mosby, Saunders)	129 (84%)
Board review course	128 (83%)
Previously released NBDHE questions	113 (73%)
Mock boards examination	111 (72%)
Strategies for studying	107 (69%)
Dental Decks (flashcards)	104 (66%)
Practice questions	104 (66%)
Strategies for test taking	101 (66%)
Strategies for reducing anxiety	97 (63%)
Face-to-face review course	95 (62%)
Mock quizzes or tests	88 (58%)
Online websites (e.g., Dentalcare.com)	88 (57%)
Computer simulated NBDHE practice	85 (55%)
Organized discussion	74 (47%)
Formal review of course content	64 (42%)
Mini-lectures	58 (38%)
Study Groups	57 (37%)
Online preparation documents posted to a web-based learning system such as Blackboard	53 (34%)
Study apps (e.g., Pass It!)	51 (33%)
Online review course	47 (31%)
Dedicated time away from curriculum to study	44 (29%)
Workshop	22 (14%)
Other resources	12 (8%)

for the NBDHE. Questions about failure rates on the NBDHE and whether or not failure rates reflected on the quality of dental hygiene programs were addressed (Table IV). A majority (65%) indicated they were not concerned with failure rates, and 43% reported failure rates do reflect on the program. Directors were asked to respond to several statements concerning their perceptions of commercial board reviews. Of those programs using a commercial review course, 59% indicated student participation was not mandatory. They supported commercial reviews for a variety of reasons with the top two reasons being: increase self-confidence in what is already known (92%), and provide familiarity with question format (92%).

Table III: Directors' affirmative responses to strategies provided directly by institution for preparing students for the NBDHE

Instructors review and update board review resource material regularly.	101 (66%)
Review occurs during the spring semester.	96 (62%)
Faculty provide board review in areas of their content expertise.	90 (58%)
Attendance is mandatory.	55 (37%)
Review occurs during the fall semester.	44 (29%)
College credit given for review course participation.	40 (26%)
Instructors are provided guidance for the writing of board review test-items.	33 (21%)
Review occurs during the summer semester or other.	19 (12%)

Data in Table V shows that directors report the mock exam helps identify student strengths and weaknesses (68%), encourages students to study (67%), provides the opportunity to review results with students (62%), and provides students with a simulation of the actual NBDHE (60%). The majority indicated that the mock board exam is offered during the fourth semester (58%) and is incorporated into a required course (56%). Program provisions for students following a poor mock NBDHE can be found in Table VI.

Differences in NBDHE preparation practices based on type of degree awarded (Associate vs. Baccalaureate) or regional location (Northeast, South, Midwest, West) were examined to address research question three. Preparation methods were grouped according to institutional, commercial, or both. A one way ANOVA was completed and identified no significant differences ($p>.05$) between the four regional locations in which the programs were located and preparation strategies ($F(3, 142) =1.75$, $p=.16$). Additionally, no significant differences were found in regard to type of strategies employed in relationship to type of degree granted ($t(142)=-.741$, $p=.46$).

Qualitative analysis of written comments resulted in the emergence of five key themes. The first theme was student preparation (35/130). Directors commented on students' willingness to study long hours, begin preparation early and prepare consistently throughout the program as key to success on the NBDHE. A strong performance in the dental hygiene program surfaced as the second theme (22/130). Directors noted students who consistently excelled in course work, had a strong work ethic, displayed motivation and strong organizational skills, were committed, prepared, confident and dedicated throughout the program were successful on the NBDHE, as well. The third theme was a comprehensive program with a strong curriculum (19/130). Directors stressed a rigorous, well designed curriculum with high expectations of students. A fourth theme was participation in a board review course, either faculty-led or a commercial review (18/130). The use of faculty-led board reviews and commercial board reviews were expressed as being beneficial. Directors stated board reviews helped students become familiar with the format of board questions, provided critical thinking exercises and helped identify areas of weakness. The strength and dedication of faculty was a fifth and final theme (14/130). Directors pointed to faculty who were committed to student success, available to students and used board-type questions or other innovative teaching methods in their courses to prepare students for the NBDHE. Experience of faculty was cited as well.

A second open ended question asked what methods or interventions directors found to be most effective in preparing students for the NBDHE. Two themes materialized with the first being the use of a review course, either institutional or commercial (41/114). Similar to the feedback provided in the question analyzed above, directors felt a review course provided students with a structured method of study for board preparation, familiarity with question format and provided students with confidence and a feeling of being prepared. The use of a mock board exam to prepare for the NBDHE arose as a second theme (16/114). Directors reported using a variety of methods to facilitate a mock board exam including previously released NBDHE questions, a weekly board review class followed by a mock board exam, and posting a mock board exam on Blackboard.

Discussion

In this study, the number one preparation strategy used by dental hygiene programs to prepare students for the NBDHE is the use of dental hygiene review texts (e.g., Mosby, Saunders), followed by a board review course. These results differ from previous studies where the use of a mock board review exam was noted as the number one preparation strategy.[1,7,27] Research of dental students found that while over half of dental programs (58%,) provide a board review course, this preparation strategy was endorsed by only 3% of students in one study as a primary source of study for the NBDE Part I.[25] Unlike dental education, nursing reports academic referral for study/test taking strategies as the most frequent strategy used for preparing their students for their written licensure examination, followed by review courses.[10] Medical schools have also reported the use of board preparation courses as a strategy to prepare students for licensing exams.[8,32,33] It is clear that review courses are valued as a study strategy by healthcare educational programs. Dental and dental hygiene students appear to be using Dental Decks as an additional study strategy, with a

Table IV: Directors' perceptions of statements relating to the NBDHE.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am concerned about the failure rates of our program's students on the NBDHE.	62 (40%)	39 (25%)	16 (10%)	23 (15%)	9 (6%)
The failure rate on the NBDHE tends to reflect on the quality of a dental hygiene program.	15 (10%)	35 (23%)	34 (22%)	50 (33%)	16 (10%)
Preparing for the NBDHE is entirely the responsibility of the student.	13 (8%)	85 (55%)	24 (16%)	23 (15%)	6 (4%)
I support students participating in a non-mandated commercial review course.	7 (5%)	1 (.6%)	14 (15%)	66 (43%)	63 (41%)
The mock board exam is a useful coaching tool in the overall process of NBDHE preparations.	3 (2%)	0 (1%)	31 (20%)	72 (47%)	43 (28%)
A mock board exam is accurate in predicting who will pass the NBDHE.	3 (2%)	35 (23%)	67 (44%)	34% (22%)	11 (7%)

majority of dental students reporting it as their primary resource.[8,25]

Seventy three percent of dental hygiene directors reported using released NBDHE questions as a preparation strategy, with 40% noting their program uses the most recently released NBDHE exam as a mock board. Several directors voiced concerns that the released exam questions were old and out of date. However, while these resources are available, the JCNDE does not recommend the use of released board exams for studying and instead encourages students to use textbooks and notes.[30] The exams currently available for purchase are from 2006 and 2009.[34] Dental students rated previously released National Board Exams as their second most utilized form of board preparation.[25] Despite the dated questions, students likely gain confidence by becoming familiar with board-type question content and format and will want to continuing using them.

It has been suggested in the nursing literature that programs have in place a formal process for identifying students at-risk of failing licensure exams. This study found 44% of directors indicating their programs do so. While this study did not seek to identify specifically what processes are used to identify students at risk of failure on the NBDHE, previous studies show the mock board exam and early course average have been used for this purpose.[1,7] It is interesting to note that only 14% of programs require

Table V: Responses of directors reporting the use of a mock board examination to statements about the mock board examination.

The mock National Board Dental Hygiene Exam…	
…helps identify student strengths & weaknesses	104 (66%)
…encourages students to study	103 (67%)
…results are reviewed with students	96 (62%)
…provides students with a simulation of the actual NBDHE	92 (60%)
…is offered 4th semester (second semester senior year)	89 (58%)
…is incorporated into a required course	86 (56%)
…identifies test anxiety	68 (44%)
…is computerized	67 (44%)
…utilizes the most recently released NBDHE exam	61 (40%)
…requires students to analyze weaknesses and develop a formal study plan for NBDHE preparation	57 (37%)
…results are used to analyze for curricular weaknesses	52 (34%)
…has undergone validity and reliability testing	45 (29%)
…is written by faculty	36 (23%)
…is offered 3rd semester (first semester senior year)	31 (20%)
…is graded and calculated into student's course average	30 (20%)
…is offered during summer session or other	15 (10%)
…must receive a passing grade on in order to graduate	12 (8%)

Table VI: Program provisions to students following a poor mock board examination performance.

Provide students the ability to review results determining their own strengths and weaknesses by content area and question type	81 (53%)
Departmental topic review sessions	42 (27%)
Recommend commercial board review courses	61 (40%)
Referral for study skills	57 (37%)
Remediation	46 (30%)
Test anxiety counseling	42 (27%)
Tutoring	40 (26%)
Other	7 (5%)

students pass the NBDHE as part of the requirements for graduation. Researchers reported that requiring students to pass the NBDHE was one strategy for increasing the likelihood that students would take board preparation more seriously.[27]

Over half of directors indicated they are not concerned with pass rates on the NBDHE. This would seem to be supported by the 95.8% pass rate on the 2012 NBDHE exam.[2] This compares with an NCLEX first time pass rate of 82% in 2014 and a 94% first time pass rate on the 2012 NBDE Part I and 95% first time pass rate on the NBDE Part II.[35,36] Clearly, dental hygiene programs are successful at preparing students to take the NBDHE. Still, this leaves 21% agreeing/strongly agreeing with the statement "I am concerned with pass rates on the NBDHE."

A majority of directors indicated that their programs do expect to assist in board preparation. And even though findings on the relationship between dental hygiene students participating in a review course and performance on the NBDHE is conflicting, the majority of directors report supporting student participation in non-mandated commercial review courses.[28-30] Not all programs encourage board reviews, and reasons given included the cost of reviews, which could be prohibitive to students, and the assertion that students who do well in course work should have the skills to do well on the NBDHE.

This study found just one third of directors agreeing with the mock board statement: "results are used to analyze for curricular weakness". Research has suggested results of a mock board could be used to identify areas in the curriculum in need of revision.[7] One director in this study commented that their program compares its scores to the national average, in all areas of testing. If the test scores are found to be average or below average, the content and teaching methodologies employed are examined to determine if there are specific areas needing improvement at the institution. This finding may indicate an opportunity for dental hygiene programs to change or revise the curriculum or teaching methods in areas where students are scoring lower on the mock boards, as well.

The quantitative and qualitative findings from this study differed somewhat, providing further insight into preparation strategy choices for the NBDHE. While directors chose "dental hygiene review texts (e.g., Mosby, Saunders)" as the most used preparation strategy for the NBDHE, when asked the open ended question "What methods or interventions have you found to be most effective in preparing students for the NBDHE?", the top theme emerging from comments was the use of a board review course. The fact that review texts ranked first in use may be due, in part, to their affordability and ease of use. However, for effectiveness, directors' number one choice of a review course is supported by other studies which cite "provide a structured format of study" and "contribute to hours of study" as reasons for supporting a review course as an effective preparation method.[8,25,26] Interestingly, when asked the open ended question, "What do you believe contributes to students' success on the NBDHE?", directors ranked "participation in a board review course" fourth of the five themes garnered from responses. "Student dedication to preparation" and a "strong performance in the dental hygiene program", were the top two themes that emerged from directors' written comments, indicating directors believe NBDHE success is multifactorial and also depends on intrinsic qualities of students.

This study focused on program directors of U.S. accredited dental hygiene programs in order to determine how programs are preparing students to take the NBDHE. There were limitations to this study. Since survey research consists of self-reported data, there is the potential for bias in the responses. Additional research might include how students self-report preparing to take the NBDHE versus how faculty self-report preparing students to take the NBDHE. Since this study found that directors were divided on the statement, "The failure rate on the NBDHE tends to reflect on the quality of a dental hygiene program", it may be revealing to explore what is behind this division of opinion in future studies. Lastly, in regard to the NBDHE as a graduation requirement, 14%

of program directors reported that students are required to pass the NBDHE in order to graduate. Future studies may seek to examine why this percentage is so low.

Conclusion:

This study reveals insights into the strategies used by dental hygiene programs to prepare students to take the NBDHE. The data suggest that the majority of dental hygiene programs use multiple strategies for this purpose, with commercial review texts and a board review course the two most common strategies found. Dental hygiene program directors supported students participating in a non-mandated commercial review course, indicating that commercial review courses increased student self-confidence in knowledge of information that is already known and provided familiarity with NBDE question format. Directors also agreed that a mock board exam is a useful coaching tool in board preparation by helping students identify strengths and weaknesses and encouraging students to study. The majority of directors are not concerned about program failure rates on the NBDHE and the majority agree that the failure rate on the NBDHE reflects on the quality of a program. In addition to a board review course, directors suggested student willingness to prepare and overall performance in the dental hygiene program were important factors in success on the NBDHE.

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Comparison of two Manual Toothbrushes in Effectiveness of Plaque Removal: A pilot study

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Abstract

Purpose: This pilot study compared the effectiveness of plaque removal of two manual toothbrushes; a novel toothbrush design and a control reference toothbrush.

Methods: Thirty-eight individuals meeting specific criteria consented to participate and were randomly assigned to one of two groups. Subjects were given both study toothbrushes eight days prior to data collection to use on alternate days for two minutes twice daily for familiarization. Subjects refrained from any oral hygiene procedures for twenty-four hours prior to data collection at which time a baseline plaque score was recorded using the O'Leary Plaque Control Record. Following the baseline plaque score recording, timed brushing was supervised by a research assistant, using a split mouth design, followed by a post-brushing plaque score. All plaque scores were recorded by the same examiner blinded to group assignment. Pre- and post-brushing scores were compared using t-tests and analysis of variance (ANOVA) to determine differences. Subjects also completed a qualitative survey on the two brushes.

Results: When compared to overall plaque scores, no significant differences were shown between the two brushes or when compared to all interproximal surfaces, all smooth surfaces and left vs. right sides. Both brushes performed better on the left side. The control brush was slightly more effective than the novel brush in the mandible ($p=0.0222$) and on lingual ($p=0.0169$) surfaces. Results of the survey showed that the subjects significantly favored the novel brush.

Conclusion: Both brushes were effective, although the reference brush was slightly more effective in plaque removal than the novel design brush in the mandible and on lingual surfaces; however, the novel brush was preferred by participants.

Keywords: This manuscript supports the revised NDHRA priority area: **Client level: Oral health care** (new therapies and prevention modalities).

Introduction

Plaque biofilm accumulation in the oral cavity is an essential etiologic factor of caries and gingivitis and plaque removal with a toothbrush has been shown to reverse the process of gingivitis.[1] The primary factors identified influencing the ability to remove plaque with a toothbrush are: length of time and frequency of brushing; the individual's brushing ability; and toothbrush design.[2] Numerous toothbrush designs, featuring a variety of bristle, head, and handle styles, have been developed to assist the user in simpler and more effective plaque removal.

Manual toothbrush studies focusing on bristle design have demonstrated that tapered, multi-level, and crisscross bristles remove more plaque than bristles that are uniform in height and diameter.[3-5] Other bristle design studies show that extended, x-angled, and conical filaments with extra-thin ends demonstrate more effective plaque removal than flat-trimmed bristles.[6-8] However, in a more recent bristle design study, investigators found that bristle design had little impact on the plaque removal capacity of a toothbrush[9] and furthermore, when a standard brush head design was compared with two flexible-head toothbrushes no differences were found in plaque removal.[10] In an in vitro study comparing a novel elastic toothbrush head to a standard brush head, the elastic brush head demonstrated greater efficacy in removing plaque.[11]

Some studies comparing novel toothbrush designs have shown that the new designs removed plaque more effectively than a standard design,[12,13] while other studies comparing novel designs to standard designs do not demonstrate a significant difference.[14,15] Results from a study on the efficacy of a novel brush head design demonstrated that a brush with angled bristles was more effective in plaque removal when compared to brushes with crisscross bristles, standard straight bristles and a battery powered brush.[16] A study of five advanced manual toothbrush designs (3 crisscross bristle designs and 2 standard straight bristles) concluded that while

all were highly effective in plaque removal, the crisscross designs showed a consistent advantage in efficacy, indicating that the crisscross design can further enhance plaque removal.[17] The wide variety of available designs in manual toothbrushes points out that dental professionals and toothbrush manufacturers are consistently searching to find more effective designs for plaque removal.

The toothbrush itself is only part of the solution of the problem of effective plaque removal. The method in which the toothbrush is used may be of equal or more importance, to the brush itself. The Modified Bass brushing technique is recommended by dental professionals and has been validated by two studies to be effective for plaque biofilm removal from the gingival third of the teeth.[18-20] The Modified Bass method requires that the toothbrush bristles be placed at a 45-degree angle to the gingival margin and moved gently back and forth followed by a roll or sweeping motion across the broad lingual or facial surfaces to clean the remainder of the tooth.[21]

A novel manual toothbrush (MD Brush™; M Davidson, Pearland, TX), as shown in Figure 1, is designed with a patented four-surface grip handle and an angled brush head featuring W-cut tapered bristles (Figure 2).[22] The brush handle to head orientation is specifically designed to aid the user in achieving the recommended 45-degree angulation of the Bass technique and includes a visual reference on the end of the handle, which when viewed in the mirror, indicates proper bristle adaptation (Figure 3). A common method for evaluating the efficacy of a new toothbrush design is to compare it to a standardized toothbrush. The American Dental Association (ADA) offers a reference toothbrush with a straight handle and a flat brush head with rounded bristles which is used specifically for toothbrush research. (Figure 4)[7, 8, 15, 23] A side by side comparison of the novel brush and the ADA reference toothbrush is shown in Figure 5.

Figure 1: Novel Brush

Figure 2: Novel Brush and ADA Reference Brush Bristles

Figure 3: Novel Brush Reference Marks

Novel Brush Specifications:

14 tufts (outer rows - white bristles) end rounded bristles - 9mm and 11mm in length (outer rows are cut at an angle so there are lengths in between these two measurements)

20 tufts (inner rows - green bristles) tapered bristles - tapered bristle length is 13mm

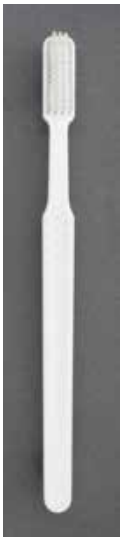

Figure 4: ADA Reference Brush

ADA Reference Brush: 47 tuft toothbrush – TYNEX® Nylon Filaments	
Specification	***Value/unit***
Trim height	*.437" +/- 0.15"*
Filament ends/tuft	*47T*
Filament diameter	*.007"*
Tuft retention	*26.8 (± 4.5) N*
Surface profile	*Flat*
Handle	
Length (inches)	*6.75 inches*
Material	*polypropylene impact copolymer*

Figure 5: Novel Brush and ADA Reference Brush

While innovations in manual toothbrushes have attempted to make brushing simpler and more effective, the numerous studies on toothbrush and bristle designs have not demonstrated a clear consensus on the ideal brush for plaque removal.[16, 17] Results from a systematic review on the efficacy of a manual toothbrush for plaque removal in adults with gingivitis showed that well-motivated, properly instructed individuals could be effective in removing plaque when using traditional manual toothbrushes and adjunctive inter-dental devices. The review also acknowledged that maintaining a relatively plaque free dentition is not easy to achieve and that new technologies and designs developed to enhance and simplify the task of plaque removal and good oral hygiene can be beneficial.[24]

This novel brush is new to the marketplace and its efficacy has not been reported in the literature. The purpose of this pilot study was to investigate the plaque removal efficacy of the novel brush as compared to the ADA reference toothbrush by assessing the pre-and post-brushing plaque indices in a study population. Furthermore, a qualitative survey was used to investigate the participants' perceptions of the novel brush and the ADA reference toothbrush.

Methods and Materials

A convenience sample of 38 first year dental hygiene students participated in the study. Inclusion criteria were: five evaluable teeth in each quadrant (excluding all third molars and all central incisors); abstinence of using any outside oral hygiene products

during the study period; no professional prophylaxis during the study period; and abstinence of any oral hygiene care and procedures for twenty-four hours prior to data collection. Third molars (teeth numbers 1, 16, 17 & 32) were excluded from analysis due to their absence in a number of subjects. Central incisors (teeth numbers 8, 9, 24 & 25) were excluded due to the tendency for over-lapping adjacent quadrants during brushing. Informed consent was obtained from the volunteer subjects and each participant was assigned an identification number for confidentiality. Institutional Review Board approval was obtained from the University of Texas Health Science Center at Houston (UTHealth) School of Dentistry for the study.

In order to familiarize participants with both study toothbrushes, participants were given the novel brush (MD) and an ADA reference toothbrush (ADA), in addition to a tube of toothpaste. A non-antimicrobial, non-fluoridated toothpaste (Tom's of Maine™ Natural Toothpaste; Colgate-Palmalive, New York, NY) was chosen as a control for confounding variables. Study participants were asked to brush twice a day with each of the prescribed brushes and toothpaste, to be used on alternate days for a total of eight days prior to the data collection session. All participants received detailed brushing instructions and a brushing log (Figure 6).

Figure 6: Instructions for Participation in Toothbrush Study

1. Brush 2 times per day, once in the morning and once at night for 2 minutes each time.
2. Alternate each toothbrush daily.
3. Brush only with the designated toothbrushes and toothpaste provided. Use no other oral products during this time such as mouth rinses, dental bleaches, etc.
4. Do not have your teeth cleaned by a dentist/dental hygienist during this time period.
5. Please use log below to place a checkmark following each brushing.
6. 24 hours prior to scheduled data collection session, please refrain from all oral hygiene procedures such as brushing, flossing and using mouthrinse.

Brushing Log

Day 1 – ADA Brush: AM____	Day 1 – ADA Brush: PM____
Day 2 – MD Brush: AM _____	Day 2 – MD Brush: PM _____
Day 3 – ADA Brush: AM____	Day 3 – ADA Brush: PM____
Day 4 – MD Brush: AM _____	Day 4 – MD Brush: PM _____
Day 5 – ADA Brush: AM____	Day 5 – ADA Brush: PM____
Day 6 – MD Brush: AM _____	Day 6 – MD Brush: PM _____
Day 7 – ADA Brush: AM____	Day 7 – ADA Brush: PM____
Day 8 – MD Brush: AM _____	Day 8 – MD Brush: PM _____

Participants were randomly assigned to one of two groups and given one MD and one ADA brush as they presented for the data collection session. The data collection sessions began with a baseline plaque record performed by a calibrated examiner using the O'Leary Plaque Control Record Index,[25-27] to note the presence or absence of plaque on six surfaces of each tooth: mesiolingual, distolingual, mesiofacial and distofacial. Disclosing swabs (HurriView™; Beutlich Pharmaceuticals, LLC, Bunnell, FL) were used to locate the presence of plaque.

Study participants then performed timed brushing with the MD and ADA brushes: Group A brushed first with the ADA in the two left-side quadrants for 30 seconds each with 15 seconds for facial and 15 seconds for lingual surfaces; the right-side quadrants were brushed next with the MD, using the same timing criteria. Group B brushed first with the MD in the left-side quadrants for 30 seconds each with 15 seconds for facial and 15 seconds for lingual surfaces; the right-side quadrants were brushed next with the ADA, using the same timing criteria. Toothpaste was not used for the timed brushing. Randomized group assignments and timing were supervised by a calibrated research assistant. A final, post-brushing O'Leary Plaque Control Record was obtained from the same examiner who was blinded to the group assignments. All plaque scores were recorded in the Electronic Health Record (EHR) and transferred to Excel files for data analysis and source documentation. The plaque scores were deleted upon completion of the data analysis from the EHR. Participants were also asked to complete a qualitative survey assessing the two toothbrushes. The anonymous paper survey was completed by each participant in a semi-private area away from the examiner and research assistants.

Data Analysis

All statistical analyses were performed using SAS version 9.3 for Windows. Descriptive statistics of the number of subjects, mean, and standard deviation were computed for various sets of surfaces described in the results. The plaque score was the percent of surfaces with plaque for each individual and each area of the mouth being considered. The

Table I: Plaque score results

Area	Plaque scores	ADA n=38 Mean (SD)	MD n=38 Mean (SD)	Brush comparison
Overall	Baseline	0.91(0.07)	0.93(0.05)	
	Post brushing	0.64(0.13)	0.66(0.12)	
	Difference	-0.28(0.12)	-0.27(0.11)	p=0.7573
	p-value	<0.0001	<0.0001	
Interproximal (DF, MF, DL, ML)	Baseline	0.97(0.04)	0.98(0.03)	
	Post brushing	0.75(0.13)	0.77(0.14)	
	Difference	-0.23(0.12)	-0.21(0.13)	p=0.4250
	p-value	<0.0001	<0.0001	
Left vs.	Baseline	0.98(0.05)	1.0(0.01)	
	Post brushing	0.76(0.14)	0.83(0.12)	
	Difference	-0.22(0.14)	-0.16(0.11)	p=0.0985
Right (p=0.0095)	Baseline	0.96(0.04)	0.97(0.04)	
	Post brushing	0.73(0.12)	0.70(0.13)	
	Difference	-0.23(0.10)	-0.27(0.12)	p=0.3863
Smooth (L and F)	Baseline	0.80(0.16)	0.83(0.11)	
	Post brushing	0.44(0.21)	0.45(0.16)	
	Difference	-0.36(0.16)	-0.37(0.15)	p=0.9138
	p-value	<0.0001	<0.0001	
Left vs.	Baseline	0.75(0.19)	0.80(0.13)	
	Post brushing	0.36(0.22)	0.38(0.12)	
	Difference	-0.40(0.20)	-0.43(0.14)	p=0.2762
Right (p<0.0001)	Baseline	0.85(0.09)	0.85(0.10)	
	Post brushing	0.53(0.15)	0.53(0.16)	
	Difference	-0.32(0.12)	-0.31(0.15)	p=0.4537
Mandible vs.	Baseline	0.97(0.05)	0.96(0.07)	
	Post brushing	0.68(0.20)	0.74(0.20)	
	Difference	-0.29(0.19)	-0.21(0.18)	p=0.0222*
	p-value	<0.0001	<0.0001	
Maxilla (p<0.0001)	Baseline	0.89(0.11)	0.89(0.11)	
	Post brushing	0.54(0.21)	0.55(0.22)	
	Difference	-0.35(0.19)	-0.34(0.21)	p=0.7826
	p-value	<0.0001	<0.0001	
Facial vs.	Baseline	0.95(0.07)	0.94(0.07)	
	Post brushing	0.59(0.21)	0.59(0.23)	
	Difference	-0.36(0.19)	-0.36(0.22)	p=0.9053
	p-value	<0.0001	<0.0001	
Lingual (p<0.0001)	Baseline	0.91(0.12)	0.91(0.12)	
	Post brushing	0.64(0.22)	0.71(0.23)	
	Difference	-0.27(0.18)	-0.21(0.17)	p=0.0169*
	p-value	<0.0001	<0.0001	

*MD and ADA significantly different

group means of the plaque scores were compared in the statistical analysis. The means (SD) proportion for the ADA group and the MD group are shown in Table I. A repeated measure, mixed model analysis was used to check for order effects of the brushes and balance for any such effect when comparing the brushes due to the split-mouth, crossover design. Two-way interactions were tested when analyzing the overall effects as well as effects in smaller areas of the mouth. Baseline plaque scores for each analysis were used as a covariate to adjust for any differences in brush comparisons. Pairwise, least significant difference t-tests were used following the mixed model ANOVA.

Results

Of the 38 enrolled subjects, all 38 completed the protocol. Data displayed in Table I shows that there were no statistically significant differences found between the novel brush and the ADA reference brush when comparing overall plaque score changes from baseline to post-brushing (ADA, -0.28 and MD, -0.27). Both brushes significantly reduced plaque (p<0.0001) overall; in the mandible on interproximal surfaces and on smooth surfaces; in the maxilla on facial and lingual surfaces. Comparisons of all interproximal sites (ADA, -0.23 and MD, -0.21), all smooth sites (ADA, -0.36 and MD, -0.37) and comparisons of left (ADA, -0.22 and MD, -0.16) versus right sides (ADA, -0.23 and MD, -0.27), also showed no statistically significant differences in baseline to post-brushing plaque scores of the two brushes. However, both the ADA and MD showed greater improvements

on the right side (p=0.0095) for interproximal surfaces and the left side for smooth surfaces (p<0.0001).

Further analysis compared the mandible to the maxilla and facial versus lingual surfaces (Table I). Both brushes were significantly better at removing plaque in the maxilla (p<0.0001) as compared to the mandible. In addition, the ADA was shown to be slightly more effective than the MD at removing plaque in the mandible (ADA, -0.29 vs MD, -0.21, p=0.0222) and on the lingual surfaces (ADA, -0.27 and MD, -0.21, p=0.0169). Both brushes were more effective on facial surfaces compared to lingual surfaces (p<0.0001).

The survey results (Table II) showed that 63% of study participants used a manual toothbrush, while 39% used a power brush for their daily brushing prior to the study. Several participants checked both categories which accounted for the >100% total. Four different brands of manual brush and two brands of power brush were named. A Visual Analog Scale (VAS: 1-10) was used for the remaining survey questions. Results showed that there was a significant difference in favor of the MD over the ADA in satisfaction with the toothbrush. A significant difference was also shown in how clean the teeth felt to the participant after brushing with each brush, with the MD the preferred brush. When asked how likely they would be to purchase each brush in the future, a significance difference was shown in favoring the MD product.

Table II: Survey question results

Q1. Type of toothbrush used	**N (%)**			
Manual	24 (63%)			
Power	15 (39%)			
Q2 to Q7 (VAS:1-10)	**Mean**	**(SD)**	**Median**	**Mean (SD) Median Significance**
Q2: Pleased with ADA	4.1	2.4	4.5	Q3 - Q2: 3.2 (3.1) 3.0 p<0.0001
Q3: Pleased with MD	7.3	1.7	7.5	
(1=not pleased, 10=extremely pleased)				
Q4: Clean feel with ADA	5.2	2.3	5.0	Q5 - Q4: 2.6 (2.3) 2.5 p<0.0001
Q5: Clean feel with MD	7.8	1.7	8.0	
(1=not clean, 10=extremely clean)				
Q6: Likely to purchase ADA	2.4	2.3	1.0	Q7 - Q6: 3.8 (3.7) 6.3 p<0.0001
Q7: Likely to purchase MD	6.2	2.9	7.0	
(1=not likely, 10=very likely)				

Participants' comments were categorized according to their written answers (Table III) on the following most common factors: bristles; handles; size; effectiveness; and no specific likes or dislikes. Answers given with the higher percentages were: handle design of MD liked most (53%); bristles of ADA liked least (47%); nothing liked about ADA (37%); handle of MD liked least (34%); bristles of MD liked most (34%); and bristles of ADA liked most (32%). The most frequent positive remarks were pertaining to the handle design of the MD. In the category of least liked characteristics, the bristles of the ADA were commented on most frequently in addition to the handle of the MD.

Discussion

Manual toothbrushes are commonly used for plaque control. Brushing technique, duration and the brush itself have been identified as important factors for effective plaque removal.[15] This cross-over split mouth study design was chosen in order to have each subject act as his/her own control by using each study brush in opposite sides of the mouth, thus eliminating the factor of one subject's brushing technique being superior to another.[7] The timed brushing sessions removed the possibility of one subject brushing longer than another. By eliminating the factors of technique and duration, this study focused on the plaque removing ability of the brush itself.

Baseline plaque scores (all>90%), indicate that the study subjects had been compliant with the stipulation to abstain from all oral hygiene procedures 24 hours prior to data collection. Plaque scores collected at baseline as compared to post-brushing plaque scores were overall -0.27 (p<0.0001). Considering technique and duration were not factors in these differences, both brushes removed less than 30% of the total plaque present at baseline, even though brushing was performed for a total of two minutes. Similar findings have been reported in comparable toothbrush studies showing no superior toothbrush design.[15] While manual toothbrush studies most commonly indicate a 40-55% plaque removal rate, others have reported 26-39% efficacy, similar to the results of this study.[15] Unlike previous studies reporting that angled bristles were superior to flat uniform height bristles, these findings were not replicated in this study.

Table III: Survey comments results

What did you like most about the ADA Reference Toothbrush?				
Bristles	Handle	Size	Nothing	
12 (32%)	6 (16%)	6 (16%)	14 (37%)	
What did you like most about the MD Brush?				
Bristles	Handle	Size	Effectiveness	
13 (34%)	20 (53%)	1 (3%)	4 (11%)	
Chi-square p-value <0.001				
What did you like least about the ADA Reference Toothbrush?				
Bristles	Handle	Size	Effectiveness	Nothing
18 (47%)	5 (13%)	8 (21%)	6 (16%)	1 (3%)
What did you like least about the MD Brush?				
Bristles	Handle	Size	Effectiveness	Nothing
8 (21%)	13 (34%)	9 (24%)	4 (11%)	4 (11%)
Chi-square p-value <0.05				

Thirty-seven out the thirty-eight study participants were right-handed. Due to the split mouth study design, right versus left-handedness did not appear to have impacted the overall comparative results. Both brushes performed better on the left side for smooth surfaces; however, both brushes performed better on the right side for the interproximal surfaces. Left and right sides were significantly different for the interproximal and smooth surfaces; however, both brushes were equally effective on the right and on the left.

Contributing factors acting as barriers to more effective plaque removal may have been poor brushing skills and the presence of the timing research assistant during the brushing phase. Additionally, toothpaste was not used during the data collection, which might have affected the subject's brushing technique, although toothpaste was not used with either toothbrush. There may be other factors involved in superior plaque removal beyond toothbrush design. Instruction and motivation from an oral health professional may play a pivotal role in effective plaque removal.

Other confounding factors may have been that all subjects were exposed to the same lecture on tooth brushing methods several days prior to the data collection session, which may have impacted how both study brushes were used. In addition, the MD packaging contained information on the Bass method of brushing and subjects had the opportunity to go to the manufacturer's website for further informational videos. The exposure to additional information and instruction factor could have influenced how either brush was used, although neither brush in this study demonstrated superior plaque removal.

Survey results show-ed that the MD was well liked by the subjects, which could point to a higher affinity for using the brush more frequently and brushing longer. A significantly higher number of respondents reported the likelihood of purchasing the MD in the future. The unique handle design of the MD garnered the highest number of written responses in the comments section of the survey. Future studies could focus on exploring the benefits of the larger handle design for persons with dexterity issues and difficulty gripping a small handle. Other implications that may be drawn from this study are that the experience of using a particular toothbrush may not necessarily be representative of the clinical outcome.[7]

This was a pilot study of a newly designed and marketed toothbrush and, as such, presented limitations. Time limitations during the first semester of the dental hygiene program allowed for only one data collection completed during week three of the semester. Prior knowledge of tooth brushing methods may be attributed to the fact that a portion of the study population had been previously employed as dental assistants. The study's small sample size of dental hygiene students was not representative of the general population.

Future research of this novel brush should be conducted using a larger population sample over a longer duration (>6 months) with a cross-over study design that includes a wash-out period. Additional studies could also assess the impact of the educational literature and online instructional videos provided by the manufacturer of this novel brush on the Modified Bass brushing method. Utilizing a broader sample from the general population rather than future dental professionals may provide greater insight on the plaque removal effectiveness of this novel toothbrush.

Conclusion

Differences between baseline and post-brushing plaque scores showed that both brushes were effective in plaque removal producing similar overall results. The ADA reference toothbrush was slightly more effective in plaque removal than the novel brush in the mandible and on lingual surfaces throughout the mouth. No other significant differences were found between the two study brushes in effectiveness of plaque removal. Survey results found that the novel brush was well received, with subjects significantly more pleased with its overall use and sense of a

cleaner feel. Subjects were significantly more likely to purchase the novel brush in the future, with the handle design receiving the highest number of positive comments.

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Disclosure

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RESEARCH

The Effect of Stainless Steel and Silicone Instruments on Hand Comfort and Strength: A pilot study

Melanie J. Hayes, BOH, BHSc, PhD

Abstract

Purpose: Many dental hygienists experience musculoskeletal pain during the course of their careers, often as a result of the sustained grips on instruments and repetitive movements employed during clinical practice. Current research suggests that lighter instruments with a larger diameter reduce force and load on the hand during scaling procedures; therefore, the texture and weight of silicone handles is designed to decrease the strain placed on the hand and fingers. The purpose of this research is to investigate and compare the effect of silicone instrument handles and traditional stainless steel instrument handles on hand comfort and strength.

Methods: This pilot study used a comparative cross-sectional study design. A convenience sample of dental hygiene students (n= 23) participated in two simulated scaling sessions for 30 minutes, one week apart. During the first session, students were required to use traditional stainless steel instruments (10mm diameter and 21-26g weight), while during the second session students used instruments with silicone handles. Students were required to complete a Hand Health Profile and perform hand strength tests following each session. Paired t-tests were used to determine significant differences between the grip strength, pinch strength and hand health profiles scores after using stainless steel and silicone instrument handles.

Results: The data analyses revealed a statistically significant improvement in grip strength ($p<0.02$), key pinch strength ($p<0.05$) and overall hand comfort ($p<0.001$).

Conclusions: This study suggests that the use of silicone instrument handles may improve hand comfort and reduce hand fatigue. These findings should prompt further investigation on ergonomic instrument design.

Keywords: ergonomics, musculoskeletal pain, instrument design, dental hygienists

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Introduction

Dental hygienists often experience musculoskeletal disorders (MSD) during the course of their careers, frequently as a result of the sustained grips on instruments, uncomfortable body positioning and repetitive movements they practice throughout the work day.[1] While these injuries can occur in any part of the body, a recent review has revealed that 42-69% of dental hygienists reported MSD in the hand and wrist region.[1] In particular, carpal tunnel syndrome (CTS) is a painful disorder involving the entrapment of the median nerve, which reportedly affects up to 23% of dental hygienists.[2] Studies have identified many predictors of hand and wrist pain, including hours working per week, poor work-life balance,[3] patients with heavy calculus,[4,5] and increasing age.[5] Pain and fatigue may be associated with decreased hand strength, and a recent study of female dentists has identified that those with a low variation in work tasks were at an increased risk of lowered strength in their right hand;[6] these findings are concerning for the dental hygiene profession, which is predominantly female and with little variation in clinical procedures.

The practice of good ergonomics is an important strategy to prevent MSD, and currently there are numerous recommendations for improved ergonomics specific to dentistry and dental hygiene. Recommended strategies for reducing the risk of MSD include the use of instruments with large diameter handles that require less gripping force, and the use textured instruments to allow for easier gripping.[7] The use of lightweight instruments (15 grams) with large diameters (10mm) requires less muscle load and pinch force, thereby reducing the strain and tension that can contribute to the development of MSD.[8] A round, tapered handle may also be beneficial.[9] Currently, there are few research studies

investigating the correlation between instrument handle materials and hand and wrist disorders. It has been suggested that the use of silicone may be a way to reduce the ergonomic stress hand instruments put on the body; this material is designed to improve ergonomics, texture and weight which consequently decreases the stress placed on the hand and wrist.[10]

A study conducted in the United States found 27.8% of respondents reported MSD as the primary cause of reduction in work hours[11] highlighting the detrimental effect a MSD has on an individual's career and income. MSD can result in increased medical expenses and workers compensation claims as well as higher levels of difficulty completing daily tasks.[12] Ergonomically designed dental instruments using silicone handles may contribute to reducing MSD among dental hygienists subsequently resulting in greater operator comfort, hand strength and overall productivity.[13] A recent study evaluating the efficacy of instruments in dentistry found that the use of thick silicone instrument handles caused the least strain, and improved work productivity, when compared to heavy, metallic instruments.[14] The aim of this research project was to investigate the effect of silicone instrument handles on hand comfort and strength when compared to traditional stainless steel instruments.

Materials and Methods

This pilot study was conducted using a comparative cross-sectional study design, to examine and compare the effect of using stainless steel instruments and silicone handled instruments, on hand strength and comfort. Institutional Review Board Approval was obtained from the University of Newcastle, Human Research Ethics Committee (H-2014-0024). Students enrolled in their second year of study in the Bachelor of Oral Health program at the University of Newcastle (n = 50) were invited to participate. This particular cohort of students was selected as a convenience sample based on having achieved a satisfactory level of competency in the use of scalers and curettes; however, the participants had not begun performing these skills on patients. In addition, the participants all had the same ergonomics instruction. Students were contacted during a lecture class session and were given a brief introduction and written synopsis of the project informing them of the nature of the research with an emphasis on the voluntary nature of the study participation. Students were given a participant information statement and a consent form to participate and could either return the completed consent form to the lecturer, or return to the on-campus clinic within two weeks.

Participants were required to attend two simulated scaling sessions, exactly one week apart, at the on-campus clinic. To limit external fatigue factors, the sessions were conducted on a day when the students did not have a preclinical scaling lab, and each student attended at the same time and on the same day of the week. In the first session, the participants were required to use the standard issue traditional instruments (stainless steel handle, 10mm diameter, 21-25g weight) in a simulated scaling task for 30 minutes. The simulated scaling task involved performing debridement of simulated calculus on quadrant four (lower right quadrant) of a typodont fitted into a manikin head. The manikin heads were set-up in dental chairs in the campus clinic. Conducting the simulated scaling task in an actual dental clinic chair ensured that the participants could appropriately position themselves and the simulated patient for optimal ergonomics. Participants were provided with a mouth mirror, periodontal probe, 11/12 periodontal explorer, H6/7 sickle scaler, jacquette scaler 34/35, gracey 1/2, gracey 11/12 and gracey 13/14. The only instruction given to the participants was to debride the simulated calculus from quadrant four for a period of 30 minutes; no specific order of instrumentation was dictated. They were then required to complete a short survey, and have their hand grip and pinch strength assessed.

Hand comfort was assessed using the Patient Evaluation Measure (PEM) survey, which is considered to be a valid, reliable and responsive tool.[15] For the purposes of this study, only questions in the hand health profile (part two of the PEM survey) were investigated. Participants responded to statements regarding the feeling, pain (level, type, duration), skill, flexibility, strength, usefulness, appearance and overall perceptions of their hands, on a 7-point Likert scale with 7 being the most negative response. Participants' pinch and grip strength were assessed using a hand held pinch gauge and dynamometer, according to the protocols included in the American Society of Hand Therapists guidelines.[16]

Participants were required to attend a second session one week later, where they were required to use instruments with a silicone handle (Flexichange®, Dentsply Ash®, Lane Cove West, NSW, AU) in the same simulated scaling task for 30 minutes. They were then required to complete the same short survey as the previous week, and have their hand grip and pinch strength assessed.

Data was analysed using the STATA software package. Means and standard deviations for all outcome measures were calculated. Paired t-tests were used to determine significant differences between the grip strength, pinch strength and hand health profiles scores after using stainless steel and silicone instrument handles. All results were expressed as t-value with degrees of freedom and 95% confidence intervals, reported as significant with $p<0.05$.

Results

Twenty-three dental hygiene students agreed to participate in this pilot study. The participants were all female, with a mean age of 25.4 years (±3.75,

Table I: Grip and pinch strength measures for dominant hand (kg)

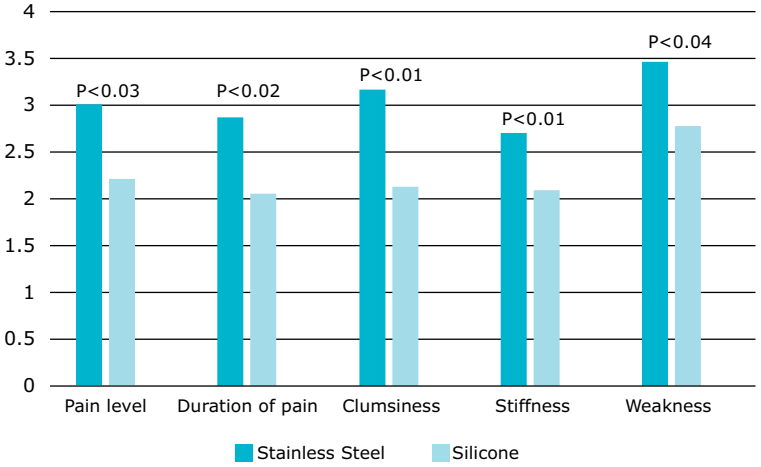
	Stainless steel Mean (SD)	Silicon Mean (SD)
Grip strength	26.12 (4.81)	27.44 (4.64)
Key pinch strength	4.51 (0.85)	4.84 (0.99)
Palmer pinch strength	4.92 (1.26)	5.07 (1.40)
Tip pinch strength	2.53 (0.87)	2.51 (1.00)

range 19-41). Means and standard deviations for grip, key pinch, palmer pinch and tip pinch strength following the use of stainless steel and silicone instruments are presented in Table I.

A paired t-test was performed to determine whether there was a statistically significant mean difference between the grip and pinch strength after participants used stainless steel instrument handles compared to silicone instrument handles. The results demonstrated that the participant's grip was stronger after using silicone instruments (27.44 ± 4.64kg) as opposed to after using stainless steel instruments (26.11 ± 4.81kg); with a statistically significant mean increase of 1.32kg (95% CI 0.22-2.43, t(22) = 2.48, p < 0.02). The participant's key pinch was also stronger after using silicone instruments (4.84 ± 0.99kg) compared with stainless steel instruments (4.51 ± 0.85kg); a statistically significant mean increase of 0.33kg (95% CI 0.00-0.67, t(22) = 2.05, p < 0.05). There was also an improvement in palmer pinch and tip pinch strength between using stainless steel and silicone instruments, although these findings were not statistically significant.

A paired t-test determined that using silicone instrument handles demonstrated a statistically significant positive change in hand health profile scores. Hand health profile scores were higher (worse) after using stainless steel instruments (30.6 ± 11.4) compared with silicone instruments (24.4 ± 9.0); a statistically significant mean difference of 6.1 points (t(22) =3.04, p<0.001). Figure 1 shows the specific questions in the Hand Health Profile that were significantly different after using the silicone instruments.

Figure 1: Participant responses to hand health questions



Discussion

This pilot study explored the effect of silicone instrument handles on hand strength and comfort compared to stainless steel handles, a comparison not previously reported in the literature. It was revealed that silicone instrument handles may assist in reducing fatigue in the hand, with a statistically significant improvement in grip strength, key pinch strength and hand comfort. Previous research has established that lightweight instruments with a larger diameter require less muscle load and pinch force[8]; it is therefore conceivable that silicone handles would reduce hand fatigue which is supported by the improved hand strength scores.

There were no statistically significant differences in palmer pinch or tip pinch between the stainless steel and silicone instruments. This may indicate that certain muscle groups fatigue more easily after using the fine motor skills required for the debridement of teeth. However, it should be noted that the mean key, palmer and tip pinch strength measures were well below the normative values for adults, as established by Mathiowetz and colleagues.[17] This may indicate that despite being students, initial training in periodontal instrumentation and debridement may already be affecting finger strength. Previous research has established that participants with CTS have decreased pinch grip.[18] The mean grip strength, while less for females established in a healthy population, were within the normative range.[19]

Participants reported that their hand felt more comfortable after using the silicone instruments, when compared with stainless steel instruments. This finding is consistent with a study by Nevala and colleagues, whereby participants involved in simulated scaling tasks reported that instruments with the thickest silicon handles were more usable and caused less perceived strain that those with thinner, metallic handles.[14] It should be noted that the instruments used in this study were color coded, which aids instrument identification and selection,[10] this design feature may have influenced the students positive response to the study instruments. It is not clear is whether the lighter weight, the larger diameter, the texture or a combination of these elements found in silicone instruments is beneficial over to the stainless steel alternatives.

Previous research has established that scaling instrumentation procedures and patients with heavy calculus deposits contribute to hand and wrist pain.[4,5] While these tasks cannot be avoided as part of periodontal instrumentation, the ergonomic risks associated with these activities can perhaps be modified through the use of alternative instrument and workplace design. The results from this study should prompt dental practitioners to consider the handle design of periodontal instruments. The 'one size fits all' approach to instrument design may not be suitable for all users and individual dental practitioners should explore which instrument handle best suits their needs. Furthermore, the regular use of ultrasonic scalers in the dental hygienists armamentarium may influence hand and wrist MSD despite the use of ergonomically designed hand instruments.

While these subjects were not yet practicing dental hygienists, this research provides promising results for the use of silicone instrument handles in reducing the prevalence of MSD. Manufacturers are constantly developing new tools and technologies to improve the work environment, and it is important to research such developments to ensure that we are able to make informed evidence-based decisions on dental practice. Nevertheless, there are aspects of the study that could be improved, and they should be noted in interpreting the results and designing future studies. All participants were required to use the stainless steel instruments in week one, and then the silicone instruments the following week; this lack of randomization increases the potential for confounding factors to be introduced during the week between tasks. Further, the sample was one of convenience; all the participants were enrolled in the same dental hygiene program, and the same institution, and as such, the results are difficult to generalize. The researchers were unable to identify any useful minimal clinically important differences (MCID) to help gauge the importance of this study's particular results. While the PEM is a valid and reliable tool, the researchers only used the Hand Health Profile portion of the tool in this study, and there appear to be no available MCIDs for this portion of the survey alone. Studies exploring the MCID of grip and pinch strength often measure the magnitude of change following serious injury or surgical intervention; such differences are unlikely to be comparable in a small pilot study such as this, where the magnitude of change would likely be different for participants with lower levels of MSDs. A power analysis was not conducted due to the small sample chosen, which also limits the application of results to the entire profession. Nevertheless, small convenience samples are useful when conducting pilot studies, as they are usually accessible and easily recruited, which is valuable when time and financial constraints are considered.

It is important to remember that the etiology of MSD is multi-factorial, and as such, one intervention alone cannot be a panacea for this occupational problem. There are of course, a number of strategies that can be employed to reduce the risk of MSD in the hand and wrist of dental hygienists, including taking regular breaks, stretching and strengthening muscles, and keeping instruments sharp.[20] Studies exploring prevention of MSD among dental practitioners should investigate a wide range of symptoms and body areas for potential benefits. For instance, research exploring the use of loupes, or surgical magnification, in the reduction of MSD has demonstrated some improvements in the area of hand and pinch grip strength.[21]

Conclusion

This pilot study suggests that the use of silicone dental instrument handles may reduce fatigue and improve hand comfort among dental hygienists. Longitudinal prospective studies into ergonomic instrument design are recommended among larger cohorts of dental practitioners to determine longer-term outcomes. Dental hygienists should consider the handle design of periodontal instruments as part of an ergonomic assessment of their individual workplace and tasks.

Disclosure

The author would like to acknowledge the support of Dentsply™ for donating the silicone instruments used in this study. The author has no financial affiliation with Dentsply™ and they were not involved in the study design or analysis.

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Survey of Knowledge, Beliefs, and Behaviors of Migrant Vietnamese Parents Regarding Young Children's Oral Health

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Abstract

Purpose: The purpose of this study was to investigate the oral health knowledge, beliefs, and behaviors of migrant Vietnamese parents of 1-5 year-olds in San Jose, California.

Method: A verbally-administered survey was conducted with a convenience sample of 45 Vietnamese parents recruited at San Jose public libraries. Following preliminary screening, written informed consent was obtained from eligible individuals. A pre-tested, structured 94-item questionnaire was used to collect information regarding parent demographics, and the parent's knowledge, beliefs, and behaviors about children's oral health. Simple descriptive statistics were used to analyze the data.

Results: Vietnamese parents acknowledged a number of basic concepts regarding early childhood caries (ECC), such as influences of sugar consumption, oral hygiene, and bottle use. Unlike other groups, they reported some familiarity with the role of bacteria in caries etiology. Oral health knowledge and beliefs, however, were not reflected in parental oral health behaviors such as supervision of children's brushing. Knowledge about the preventive role of fluoride was limited and varied among the population. Parental knowledge and behaviors did not vary by education level or length of residence in US.

Conclusion: Vietnamese parents demonstrated reasonably good oral health knowledge, but poor behavioral guidance of their children's oral health, indicating the need for continued parental education emphasizing age-appropriate oral care and the preventative role of fluoride.

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Introduction

Early childhood caries (ECC), the most common chronic infectious disease of childhood,[1-2] is defined as having at least one decayed, missing, or filled tooth in the primary maxillary anterior region before the age of 71 months.[3] In children younger than three years of age, any sign of dental decay is considered severe ECC (S-ECC). From age three through five, one or more cavitated, missing, or filled surface(s) in primary maxillary anterior teeth or a decayed, missing, or filled score of at least four (at age three), at least five (at age four), or at least six (at age five) surfaces constitutes S-ECC.[3]

In the short term, ECC not only impacts the child's ability to eat, play and sleep due to the pain associated with toothache, it can also cause systemic infection and abscesses.[4-6] Once the decay reaches the stage when the disease management becomes difficult in an out-patient clinic or dental office setting, hospital admission may be required for surgical treatment under general anesthesia.[7,8] In the longer term, children who chronically suffer from ECC are more likely to develop further dental problems in adulthood.[9-11] In addition, poor oral health interferes with nutrition, concentration, and school participation; therefore affecting growth and cognitive development.[3-4,6] Left untreated, dental caries increasingly interferes with psychosocial functioning when it is associated with speech, communication problems and low self-confidence, hence diminishing a child's quality of life.[2, 4,11,12.]

ECC does not affect all populations equally.[2, 13-17] Among North American children in general, the prevalence of this condition was 28% for the two to five-year old age group in 2006.[18] The prevalence of ECC could be as high as 70% in young children from socio-economically disadvantaged populations, such as low-income, migrant or rural populations, even within developed countries.[2,13-19] Studies in the United States show that ECC and untreated tooth decay are especially prevalent in children of Asian and Latino/ Hispanic descent.[14,18-20]

Over fifty percent of the children from families living below the federal poverty level in Santa Clara County, California, entered kindergarten with a history of cavities, and more than 30% had untreated

decay as shown in the 2010 county health profile.[21] This high prevalence of caries and untreated decay observed among 5 year olds entering kindergarten can be attributed, in part, to the large Vietnamese population in Santa Clara County. In 2010, the Vietnamese population, comprising more than 1.5 million people of all ages, was the fourth largest among all Asian population groups in the United States.[22-23] Vietnamese populations are predominantly concentrated in large metropolitan areas such as San Jose, the largest city in Santa Clara County.[22,24] This county has the second largest Vietnamese population in the U.S., and 8 percent of the total 134,525 Vietnamese population in San Jose were aged five or under when the last census was taken in 2010.[23-24] High rates of ECC are not unique to the Vietnamese children in Santa Clara County. Studies of other immigrant Vietnamese populations in Australia and Canada,[25-27] in addition to a survey completed in Vietnam,[28] also documented high caries rates among children.

While the etiology of ECC includes biological,[29,30] behavioral and psychosocial [2,4,15,16,31] mechanisms, interventions to prevent or arrest caries are diet modification,[32] exposure to fluoride,[33-34] and suppression of oral microflora.[35,36] Caries development depends on interactions between biological, behavioral, cultural, social and environmental factors.[37] Children's oral health status is greatly impacted by their parents' oral health knowledge and beliefs. Previous studies suggest that parents' oral health knowledge and behaviors are associated with children's oral health status and well-being.[38-39] Parents, particularly mothers, are the main source of the early education that will influence and promote good oral health, and play a key role in establishing children's diet and oral care behaviors.[40-46]

Little research has been directed to exploring the knowledge, beliefs, and behaviors of Vietnamese parents that may be affecting their children's oral health. A better understanding of the oral health beliefs and values of Vietnamese parents is essential in order to develop the strategies to alleviate oral health disparities in this population. The purpose of this study was to survey Vietnamese parents of 1-5 year-olds in the San Jose, California metropolitan area, to determine their knowledge, beliefs, and behaviors regarding children's oral health.

Methods

A quantitative survey was used to gain understanding of migrant Vietnamese parents' knowledge, beliefs, and behaviors surrounding children's oral health. This approach consisted of a verbally-administered questionnaire to identify parents' oral health understanding, opinions, and oral health practices. The study was conducted in a primarily low-income Vietnamese community in San Jose, California and was given Institutional Review Board approval from the University of California, San Francisco. Following an initial face-to-face meeting with the principal investigator, the San Jose public library system granted written permission to conduct the survey research in their libraries. By conducting the study at four different library locations, a mixture of Vietnamese participants living in San Jose was ensured.

This study used the Basic Risk Factors Questionnaire (BRFQ) developed by a team of oral health researchers from three universities with expert opinions on dentistry, dental hygiene and dental public health. It had been pre-tested on parents with similar socio-economic backgrounds to the Vietnamese population in this study. The questionnaire was modified based on peer feedback, relevant literature review and pre-testing. For this study, the BRFQ was translated from English to Vietnamese, back-translated and reviewed to ensure content validity. It was then piloted using a small sample of 10 Vietnamese individuals in similar circumstances to those intended to be enrolled in the formal study, to ensure that the survey was comprehensible and feasible to administer. Questions addressed family socio-demographic details, and parental oral health knowledge, beliefs, and behaviors.

The complete BRFQ questionnaire consisted of 94 closed-ended questions with multiple, fixed-choices for participants to select as the option he/she felt best answered the question posed. The options were available for the participant to read as well as to hear as the interviewer conducted the study. The survey questions were designed to be able to be answered by a person with a fifth grade education. A single, bilingual interviewer, the principal investigator was used throughout the study. On occasion, the interviewer made note of spontaneous comments by participants when they elaborated on or discussed pertinent issues not otherwise directly addressed in the BRFQ question.

This standardized question-answer format reduced potential biases arising from the interviewer posing a question and recording a verbal answer in its entirety. Potential biases could come from the interviewer mishearing or misunderstanding a verbal response or becoming fatigued or only partially noting responses during the relatively long time it took to administer the BRFQ (30-50 minutes). As only one interviewer was involved, inter-rater calibration was not necessary. Intra-rater reliability was also addressed. The interviewer was thoroughly trained to ensure familiarity with the instrument, question and answer formats, and study purpose. Periodic checks were done to ensure uniformity in administering the BRFQ across a range of locations and occasions. The instrument itself did not influence responses as the participants were not provided with the correct answers from a dental science perspective until the survey had been completed.

There were 30 questions most centrally relevant to early childhood caries and the oral health of young children. Scoring was based on a Likert-scale (four to six points e.g. "strongly disagree to "strongly agree"). Examples of main questions that generated the data analyzed in this article are: "Cavities are caused by germs"; "My child is less likely to get cavities if a dentist or other care provider puts fluoride on his/her teeth"; and "How often do you or another adult help your child brush his/her teeth?"

Potential Vietnamese-speaking study participants were recruited from four different San Jose public libraries via convenience and snowball samplings. To participate in the study, subjects had to be at least 18 years of age, self-identify as Vietnamese, be a parent who regularly cared for a child/children 1-5 years old, be able to speak Vietnamese and provide written informed consent. The bilingual investigator (U.N.) approached people who looked as if they met these criteria, asked in Vietnamese if they spoke Vietnamese, if they had a child/children 1-5 years old and would like to participate in the study. The investigator explained the study purpose in Vietnamese, answered questions and indicated the approximate time involvement in addition to assuring confidentiality.

A total of 189 potential participants were screened for eligibility; 37 did not meet the criteria. Forty-five (29%) eligible parents met the inclusion criteria and gave written informed consent. Participants who completed the survey received five dollars cash compensation for their time and assistance.

The data were collected from January to April 2012. Each interview took approximately 40 minutes. In a private room at the library, the investigator verbally administered the questionnaire with each participant, making sure the subject understood the meaning of each question and could read as well as hear the answer options. The investigator marked the answers on a coded paper copy of the questionnaire during the interview process. At the end of the day, data were then entered into a computer, encrypted with passwords. Hard copies of the surveys were kept in a locked cabinet in the researcher's private office.

Data analysis involved simple descriptive statistics, mean, frequency and proportions, to describe the study population.

Table I: Descriptions of participants' oral health knowledge (N=45)

Statements/Questions	Responses N (%)				
	Strongly Disagree	Disagree	Neutral/ Don't Know	Agree	Strongly Agree
Cavities are caused by germs in the mouth	5(11)	2(5)	4(9)	3(7)	31(69)
Going to bed with a cup or bottle with anything in it but water can hurt a child's teeth *	4(9)	3(7)	3(7)	15(34)	19(43)
Children can get cavities as soon as their first tooth comes in *	6(14)	4(9)	7(16)	8(18)	19(43)
Fluoride varnish helps fight cavities	6(13)	1(2)	13(29)	15(33)	10(22)
At what age should a child stop being fed from a baby bottle?	**N (%)**				
Age ≤ 1	21(46)				
Age 1.5	4(9)				
Age 2	12(27)				
Age 3	4(9)				
Age 4-5	4(9)				

*N=44

Results

The demographics of the study population indicated that although all participants were born in Vietnam, they had resided in the United States, from 1 to 22 years. Approximately 50% of the study population had finished grade 12 or had earned a General Education Diploma; about a 25% finished a four-year college degree or higher. Despite the high education level, approximately 24% were from households living below the Federal Poverty Level. This coincides with the percentage who participated in the Women Infant Children (WIC) supplemental nutrition program for low-income mothers.

Oral Health Knowledge

The Vietnamese participants demonstrated a range of oral health knowledge (Table I). The majority of the participants knew about the etiology of dental caries; that cavities are caused by germs, and that putting a child to bed with a bottle of sugary liquid is harmful. Almost two-thirds (62%) of the participants agreed that children could develop cavities as soon as the tooth erupts, and the same proportion of participants knew that they should stop bottle feeding at 1 year old. However, 45% of the participants, did not acknowledge the role of fluoride varnish played in preventing cavities.

Oral Health Beliefs

While a majority (77%) perceived dental problems to be serious for a child and felt that children should see the dentist even when there is no problem, almost half of the survey population thought that primary teeth were not as important as permanent teeth (Table II). Sugary snacks and drinks were deemed harmful by a substantial majority of participants (81%). On the other hand, beliefs about the preventive role of fluoride widely varied; almost half of the participants felt positive about fluoride and half felt negative.

Oral Health Behaviors

About half of the participants reported that their children brush their own teeth twice a day while 23% of the respondents reported that their children never brushed their own teeth (Table III). None of the participants reported assisting his or her child with tooth brushing on a regular basis. More than half of the participants reported that their children did not frequently consume sugary drinks and/or snacks before going to bed. Almost a third of the participants did not know if their child's toothpaste contained fluoride. Two of the study respondents reported the practice of pre-mastication.

Routine dental care for children was reported by 75% of the study population (Table IV). Of the proportion of children who received routine dental care, more than one third had accessed care during the past year due to tooth decay or pain.

Discussion

This study presents an overview of the knowledge, beliefs, and behaviors of a population of urban, migrant Vietnamese parents regarding their young children's oral health. Generally, these findings are consistent with previous studies conducted on the perceptions of caregivers from similar populations.[38-46] Specifically, that parents acknowledge a number of the basic concepts of ECC etiology including the influences of sugar consumption, oral hygiene, and bottle use; that knowledge about the preventive role of fluoride is limited and varied among the population; and, that oral health knowledge and beliefs of parents were not reflected in certain aspects of child-focused oral health behaviors, such as supervision of brushing.

Contrary to some previous findings,[43,46] these results indicate that a high proportion of parents know about the biological mechanisms of caries etiology. These findings, however, do not necessarily imply that the parents in the study population possess in-depth

Table II: Descriptions of participants' oral health beliefs (N=44)

Statements	Responses N (%)				
	Strongly Disagree	Disagree	Neutral/ Don't Know	Agree	Strongly Agree
Dental problems can be serious for a child	3(7)	4(9)	3(7)	10(22)	24(55)
There's no need to go to the dentist unless children have a problem	23(52)	11(25)	2(5)	3(7)	5(11)
There's no need to worry about baby teeth because they will just fall out	15(35)	5(11)	5(11)	13(30)	6(13)
Sugary snacks and drinks can hurt children's teeth	2(5)	4(9)	2(5)	5(11)	31(70)
My child is less likely to get cavities if a dentist or other care provider puts fluoride on his/her teeth	4(9)	5(11)	17(39)	8(18)	10(23)

Table III: Descriptions of participants' oral health behaviors (N=44)

Questions	Response N (%)
How many time does your child brush his/her own teeth a day?	
Never	10(23)
Rarely	3(7)
Once	4(9)
Twice	23(52)
> Twice	4(9)
Don't know	0
How often does your child drink sweet or sugary drinks? (For example: juice, soda, pop, lemonade, Coke, Pepsi, Mountain Dew, Kool-Aid, Gatorade, etc.) Exclude any diet drinks	
Never	6(14)
Rarely	19(36)
Once	29(46)
Twice	1(2)
Don't know	1(2)
How often do you or another adult help your child brush his/her teeth	
Never	11(25)
Rarely	4(9)
Sometimes	29(66)
Always	0
Don't know	0
When your child's teeth are brushed, is fluoride toothpaste used?	
Yes	27(59)
No	5(11)
Don't know	12(27)
Does anyone else pre-chew food to feed child?	
Yes	1(2)
Starting Age (years)	0.5
Stopping Age (years)	3

knowledge about the role of bacteria in caries etiology and mechanism of transmission of dental caries.

Two participants reported the practice of pre-mastication to feed their child. Pre-mastication is pre-chewing of food for the purpose of physically breaking it down in order to feed another who is incapable of chewing the food. This is sometimes done by parents, relatives, or possibly caregivers to produce baby food during the weaning period.[47-49] These participants also reported that their child had received pre-masticated food until they were two and three years of age, respectively. Length of residence in the United States appeared to have little impact on this practice as there was a considerable difference in the length of time that these two participants had spent in the United States: one having been here for only two years and the other for 16 years. The latter participant, however, did not pre-masticate herself but rather knew someone who did that for her child while the other participant pre-masticated the food herself. Although this occurred in a very small percentage of the study population, it is interesting that this phenomenon still exists within a developed country. Furthermore, this practice could be detrimental for a child with a high risk for ECC, if the parents were experiencing active dental caries.

Table IV: Descriptions of dental access behaviors (N=44)

Questions	Mean or N (%)
How old was your child when he/she first saw someone for dental care?	2.5
During the past year, has your child been to the dentist for routine check-up?	
Yes	33(75)
During the past year, did your child see a dentist due to cavities or toothache?	
Yes	12(27)

This study demonstrates that the vast majority of parents seek routine dental care for their children. This finding is confirmed by the oral health beliefs which shows that the proportion of participants who perceived dental problems to be serious for a child was the same proportion of participants who opposed the statement: "There's no need to go to the dentist unless children have a problem." Of the proportion of children who received routine dental care, more than one third stated that they had accessed care during the past year due to cavities or toothache.

Vietnamese parents in this study tended to first seek dental care for their children around 2.5 years of age, which is similar to the results from the 2009 Delta Dental Children's Oral Health Survey from the general population.[50] This is much later than the recommendation of the American Association of Pediatric Dentistry (AAPD), which states that a dental home should be established for infants and young children six months after the first tooth erupts or by 12 months.[51] Early dental visits with a specialized primary dental care provider who performs oral health care and examination, provide an opportunity to implement preventive dental health habits that meet each child's unique needs and keeps the child free from dental or oral disease. However, almost half of the parents in this study agreed that there's no need to worry about baby teeth, a similar result reported in other studies in which caregivers agreed that concern for the deciduous dentition was unnecessary.[52]

The AAPD also recommended that tooth brushing should be performed for children by a parent twice daily [3] and it is generally accepted that this should continue until the child is at least six years of age. The data from this study indicate a lack of compliance with this recommendation. No respondent reported assisting their children with tooth brushing on a regular basis, and a third of the sample reported that they never or rarely assisted their child. This strongly indicates a lack of parental involvement and the need for parental education and behavioral skill–building in this aspect of oral self-care.

Overall, parents showed mixed knowledge and beliefs in the role of fluoride in caries prevention. The topical effect of fluoride in reducing caries from toothpastes, mouth-rinses, professionally applied fluoride varnish and gels is well established.[53-55] However, almost half these participants either didn't know or disagreed with the statement that "fluoride varnish helps fight cavities". This finding is confirmed by similar results to the survey question "my child is less likely to get cavities if a dentist or other care provider puts fluoride on his/her teeth". Furthermore, almost one-third of the parents did not know if their child's toothpaste contained fluoride. These findings provide evidence that Vietnamese parents have limited knowledge on the role of fluoride.

Limitations

One limitation of this exploratory study is the small and non-random sample, which makes it unfeasible to calculate statistical significance among variables. The use of a single interviewer is also a limitation. There could also be sample selection bias as participants were recruited from one type of location—public libraries. It is not known whether the Vietnamese population who visit the library would have similar knowledge, beliefs, and behaviors to the Vietnamese population at-large in San Jose. Gathering data on several occasions and across different locations partially mitigates these issues. Generalization to other Vietnamese populations in different regional settings or with different socioeconomic backgrounds should be undertaken with caution. Recall bias could be another possible limitation, as participants were asked to respond to questions regarding past behaviors; for example, "In the past week, how often did you child eat or drink something other than water after brushing and before going to bed?" Social desirability may also affect the responses since this was a verbally administered questionnaire. It is possible that participants responded in ways they feel that they should, rather than reporting how they actually behave. For example, they may have been heard or seen on the public media that people should brush their teeth twice a day. It is also possible that they wished to make a good impression with the interviewer and so provided answers that they knew were ideals to aim for rather than actual behaviors or goals they had achieved. While social desirability is a possibility, the pattern of mixed responses to many items suggests that this did not it occur in this particular study.

Currently, clinical oral health data on the status of Vietnamese children aged 5 and under has not been reported in the literature. This is a unique study in that it investigates characteristics of immigrant Vietnamese parents concerning their young children's oral health and as such, it makes a contribution to the literature despite its limitations.

Recommendations

Further research is required to identify strategies for targeting Vietnamese parents to receive appropriate oral health education and advice. Public health advocates and oral health professionals should focus on parent education that will increase parental oral health behaviors necessary for caries prevention when implementing oral health promotion strategies to lessen oral health disparities.

Conclusions

In general, most Vietnamese parents had reasonably good knowledge and beliefs about the etiology of dental caries, but this was not adequately reflected in their behaviors, as evidenced by delay in seeking initial oral health care and lack of parental guidance of their children's daily oral hygiene care. Parents exhibited limited knowledge of the preventive role of fluoride. There is a need for parental education emphasizing the preventive role of fluoride and the development of age-appropriate oral care behavior aimed at assisting their young children to acquire and maintain good oral care habits.

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Bone Loss in Furcation-involved Mandibular Molars: A Retrospective Analysis

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Abstract

Purpose: The purpose of this retrospective study was to determine whether teeth with furcation involvement lose significantly more bone in furcation sites over time than interproximal sites of the same tooth.

Methods: Existing radiographs were analyzed to compare the rate of bone loss between furcation and interproximal sites of the same tooth. Selection criteria included mandibular molars with furcation involvement and a minimum follow-up of 5 years. Using ImageJ software, anatomical landmarks were located and measured corono-apically.

Results: Bone level change over time averaged 4.22 % ± 2.49 for interproximal sites and 4.55% ± 2.84 for furcation sites. Significant difference in bone loss was noted in furcation sites between compliant (a minimum of one periodontal maintenance appointments per year) and non-compliant (fewer than one periodontal maintenance appointments per year) sub-groups. No other sub-group variables were associated with significant bone loss.

Conclusion: There were no significant differences in bone loss between furcation sites and interproximal sites of the same tooth. Compliant patients lost significantly less bone in furcation sites than non-compliant patients. Periodontal maintenance therapy may provide more effective debridement for mandibular molars that exhibit radiographic furcation bone loss than previously thought. Clinicians are encouraged to expand and explore a non-surgical approach for maintaining multi-rooted teeth with furcation involvement.

Keywords: furcation involvement, bone loss, molar tooth loss, dental radiographs, periodontal maintenance

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Introduction

Periodontal attachment loss around multi-rooted teeth has been shown to lead to progressive exposure of the furcation area. In general, furcation-involved teeth are not amenable to definitive and predictable management with conventional periodontal procedures.[1,2,3] Even with attention from the most dedicated patients and practitioners, furcation-involved teeth frequently perpetuate marginal inflammatory changes and continuous periodontal breakdown. Thus, the furcation area raises considerable challenges for clinical management, in both treatment and follow-up care.[4,5,6,7] Research studies have inferred that there is greater potential for periodontal destruction in furcation sites than in the interproximal sites of the same molar tooth.[1,4,8]

Clinical assumptions that periodontally involved furcation sites negatively affect the overall health and longevity of molar teeth, may unduly influence treatment decisions. Recommendations for multiple and complex procedures for the treatment of furcation involved teeth, and the anticipation of the strict maintenance care needed afterward, may lead patients to feel discouraged about retaining and maintaining their teeth. Patients may opt for extraction over keeping their natural teeth in an era of dental implant therapy options and reports of high success rates. When discussing treatment options for periodontally involved molars, a poor or compromised long-term prognosis is routinely given.[9,10] The degree of furcation involvement often serves as a prognostic factor and influences the selection of definitive and sometimes irreversible treatments.[11] However, in studies summarized by Nabors and O'Leary, molars with furcation involvement have been shown to survive and function for many years and demonstrate that furcation involvement classification alone should not condemn a tooth to an unfavorable prognosis.[12] Miller, et al. also reported that furcation involvement did not affect the tooth survivability as much as other factors.[8]

Few studies in the current literature focus on the differences between the clinical attachment

in furcation sites versus the non-furcation, i.e. interproximal sites, of the same tooth. Kalkwarf et al. claimed that even with regular periodontal maintenance, periodontitis in furcation sites progressed at a different rate from other tooth surfaces and that the involved sites tended to lose clinical attachment level regardless of the therapy provided.[1] However, it must be noted that these authors evaluated data for probing depth changes in furcation sites only, without reporting changes for the other tooth surfaces. Nordland et al. investigated the probing attachment loss on "non-molar sites, molar flat surface sites, and molar furcation sites" and found that furcation sites had the highest percentage of attachment loss.[4] Waerhaug et al. reported in his stereomicroscope study of 34 extracted molars, that attachment loss and marginal gingivitis on surfaces facing the furcation was greater than that on the outer surfaces.[13] These authors recorded an average attachment loss of 62.8% on the furcation surfaces and 47% in the interproximal surfaces of the same tooth and concluded that attachment loss was more likely in the furcation sites than on the outer interproximal sites of the same tooth. In their study, Waerhaug et al. estimated the clinical attachment loss based on staining methods used on the extracted teeth and did not assess the amount of bone destruction. Subsequently, Rams et al. reported no significant differences in the risk of periodontitis recurrence between molar furcation sites and molar flat sites, or when compared to other molar sites. They concluded that molar teeth, as a whole, show elevated risks of periodontitis, not molar sites with furcation involvement or flat surfaces individually.

At the time of this review, no published information was found comparing the rate of bone loss in furcation sites to the interproximal sites of the same tooth. The aim of this retrospective study was to determine whether teeth with furcation involvement loose significantly more bone in the furcations over time than the interproximal sites of the same tooth. A secondary aim of this study was to determine whether gender, age, interproximal restorations, systemic disease, the periodontal health of the adjacent teeth and compliance with periodontal maintenance care, have an effect on bone loss in the furcations as compared to the interproximal areas of the same tooth.

Materials and Methods

This study was approved by the Institutional Review Board of the University of Southern California (approval # UP-08-00149). Patient record selection for inclusion in the study population was completed by reviewing all available archived paper charts and radiographs at the University of Southern California, Herman Ostrow School of Dentistry. An estimated 7000 patient paper charts were reviewed and searched, up to and including, January 2009 for samples that could contribute a 5-year history and meet the inclusion criteria. Study inclusion criteria were as follows: periapical radiographs of mandibular first and second molars with radiographic furcation involvement (molars with restorations covering the CEJ were only included if the same restorations were present in subsequent x-rays); clear anatomical landmarks allowing for linear measurements to be taken between the fixed reference point (CEJ or restoration margin, fornix) and the radiographic apex; a minimum 5-year history of radiographs; comprehensive information on age, gender, presence of a medical conditions, tobacco use status, compliance with and frequency of periodontal treatment recommendations. Presence or absence of adjacent teeth and the presence of interproximal restorations was noted. Clinical variables including probing depths, clinical furcation involvement, mobility, and clinical attachment loss were not included as part of the data set due to incomplete and inconsistent data collection recorded in the patient charts.

Exclusion criteria were as follows: minimal or immeasurable bone loss from the fornix to the alveolar crest in the furcation area; diagnostically unacceptable or unclear anatomical landmarks; excessive image distortion (obvious elongations or foreshortening of the teeth and surrounding structures); presence of infrabony defects; and presence of root resorption or periapical lesions in either baseline or subsequent radiographs. Patient charts with documentation of local antibiotic therapy and/or periodontal surgical treatment, including osseous surgery, root resection, or tunneling procedures performed on the selected tooth during the time frame of the study, were also excluded. Charts selected for the study were included only if the patients had been on a periodontal maintenance schedule including oral hygiene instruction and professional dental cleaning at either the Ostrow USC School of Dentistry pre-doctoral clinic or dental hygiene clinic. The periodontal maintenance regime over the study period was recorded. Patients, who had presented for at least one nonsurgical periodontal maintenance visit per year, were classified in the compliant group.

All radiographs used in this study were taken and processed using conventional, film-based standard equipment. All radiographs selected for the study were then scanned using a flatbed scanner (Epson Expression 10000XL-Graphic Arts Scanner, Epson America Inc., Long Beach, CA, USA) to a 500 x 400 dpi resolution, 10-bit grey values and then transferred to a computer (IBM-PC, Lenovo, New York, USA) PC: 1.83 GHz. Digital manipulations were performed and measured using image analysis software for Windows (ImageJ 1.32j, National Institutes of Health). ImageJ is a public domain Java image processing program, based on NIH Image, which calculates area and pixel value statistics for user-defined selections.[15]

Contrast of the images was enhanced by using background subtraction tool. All radiographs were evaluated under 10-fold magnification. Anatomical landmarks, CEJ, restorative margins, alveolar crest, furcation fornix, and root apicies, were identified on the radiographs. The alveolar crest level was apical to furcation fornix in order to be included in the study. A single observer was used in this study to detect the radiographic landmarks. The observer's measurements were repeated and averaged to help avoid study errors, promote consistent uniformity and maximize the sensitivity for detecting radiographic changes.[16] Periapical radiographs were used to measure bone loss between the fixed reference points[17,18] in percentage of the entire root length rather than millimeter measurements (Figures 1 and 2).[19-22] After fixed points were identified, both images were adjusted so that the angulation difference was minimized. Although this method does not provide the bone loss in absolute numbers, the technique allows for comparison of bone levels in the same tooth in sequential radiographs. The influence of methodical and elongation errors was introduced into all sample results, and errors in this technique were reported to be as small as 2%.[23]

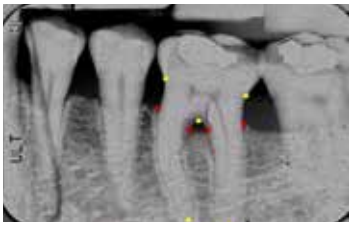

Figure 1: Baseline Periapical Radiograph

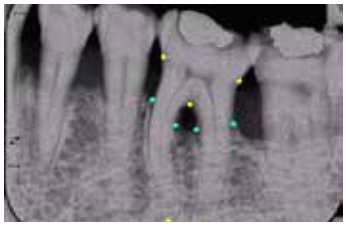

Figure 2: Follow up Periapical Radiograph

Cemento-enamel junction (CEJ), alveolar crest (AC), furcation fornix (Fx), and root apex (Ax) were identified on the baseline and subsequent radiographs. Linear measurements between the fixed reference point (CEJ or restoration margin) and radiographic apex were made along the root surfaces on both mesial and distal roots using ImageJ.[23] The program set the linear distance from CEJ or restoration to the radiographic apex at 100%, denoting the total root length. The linear distance between the apex and AC, as well as fornix and AC were assessed and recorded for each root. Each time a different root or radiograph was chosen the root length was re-measured and set at 100%. The same measurement was repeated on each subsequent radiographic image and recorded. The mesial and distal root surface measurements were not averaged together and were used in the calculation separately from each other. Radiographs were further reviewed to record presence or absence of an adjacent tooth. The condition of having a tooth adjacent to the test tooth surface was referred to as "adjacency" in this study.

The means of the radiographic measurement were compared using statistical tests. All p-values were calculated using non-parametric tests. The Wilcoxon signed-rank test was used for differences between interproximal and furcation bone loss. The Wilcoxon rank-sum test was used for differences between subgroups. A p-value ≤.05 was considered statistically significant.

Results

Twenty-six sets of periapical radiographs were obtained of mandibular first and second molars (20 first molars, 6 second molars) with radiographic furcation involvement in all 18 patients (Table I). Mesial and distal root surfaces were measured separately and were analyzed individually as sites (total = 56 sites). Demographic characteristics of the study population are shown in Table I. The average age of the patients at the baseline radiograph was 61 ± 9.8 years (range: 41 to 81 years). Patient records were arbitrarily divided into two groups, age 60 and younger and older than 60 (n = 10, age ≤ 60; n = 8, age > 60). Eleven patients had reported medical conditions (hypertension, diabetes, thyroid disease, hypercholestremia, or arthritis). One patient had reported an active history of tobacco use. All patients had received nonsurgical periodontal maintenance therapy; however, the periodontal recall schedule varied from patient to patient (intervals of 4 to 24

Table I – Demographic characteristics of the study sample.

	Patients (N = 18)	Teeth (N = 26)
Patient characteristics:		
Age:		
61 yrs ± 9.8 (41-81)		
≤ 60 y.o.	10	12
> 60 y.o.	8	14
Gender:		
male	11	18
female	7	8
Systemic disease:		
present	11	13
absent	7	13
Periodontal recall:		
compliant	14	14
non-compliant	4	12
Analysis time-frame (years):		
Mean ± SD	6.31 ± 2.4	
Range	5 - 12	

months). Following the 5-year study period, the sample teeth in 14 patients were still intact, and 4 patients had subsequently had the sample teeth extracted. The study follow-up time ranged from 5 to 12 years (mean = 6.3 years).

Presence or absence of an adjacent tooth and of any interproximal restoration was noted on individual interproximal sites on the radiographs. There were 17 teeth that had either full coverage restorations or interproximal restorations on one surface (mesial or distal), leading to total of 30 sites. There were 37 interproximal sites that were positioned by an adjacent tooth and 15 sites that were adjacent to an edentulous area.

Bone loss was compared between interproximal and furcation sites within the same tooth. No significant differences were found between mesial and distal sites of the same tooth; therefore no attempt was made to differentiate them further. In comparing baseline and subsequent periapical radiographs of furcation-involved teeth, the overall average bone loss was 4.22 % ± 2.49 for the interproximal sites and 4.55% ± 2.84 for the furcation sites (Table III). The annual average bone loss was 0.88% ± .61 for interproximal sites and 0.96 % ± .74 for furcation sites (Table II). No significant differences in overall or annual bone loss rates were found between the interproximal sites and the furcation sites.

Various parameters were reviewed to detect possible associations between bone loss including age, gender, presence of systemic disease, interproximal restorations, adjacency, and compliance to periodontal recall within 12 months (Table II). Other than compliance with periodontal recall schedule, no parameters were significantly associated with bone loss between the interproximal and furcation sites. A more regular recall schedule resulted in statistically less bone loss over the furcation site (p = 0.04) than in records indicating patient non-compliance with the recall schedule. The interproximal sites showed no statistical differences in relation to compliance. There was a trend for greater bone loss in interproximal sites adjacent to an edentulous area than in those adjacent to another tooth; however, the difference was not statistically significant.

Table II: Overall and annual bone loss in total root length by subgroups **

	Overall		Annual	
	Interproximal sites	**Furcation sites**	**Interproximal sites**	**Furcation sites**
	mean % (SD)	mean % (SD)	mean % (SD)	mean % (SD)
Total	4.22 (2.49)	4.55 (2.84)	0.88 (0.61)	0.96 (0.74)
Age				
≤60	4.82 (2.10)	5.08 (3.48)	0.99 (0.67)	1.01 (0.89)
>60	3.47 (2.87)	3.89 (1.75)	0.75 (0.53)	0.89 (0.55)
Gender				
male	3.96 (2.41)	4.20 (2.76)	0.89 (0.57)	0.97 (0.85)
female	4.63 (2.76)	5.10 (3.09)	0.87 (0.70)	0.93 (0.60)
Presence of interproximal restorations				
Yes	4.45 (4.00)	4.45 (3.22)	0.88 (0.95)	0.82 (0.60)
No	4.64 (2.06)	4.25 (2.59)	1.09 (0.65)	1.07 (0.98)
Adjacent to another tooth				
Yes	3.52 (2.42)	4.19 (3.39)	0.74 (0.66)	0.86 (0.84)
No	6.98 (3.24)	3.40 (0.62)	1.55 (0.01)	0.86 (0.84)
Presence of systemic diseases				
Yes	3.90 (2.44)	3.56 (2.22)	0.89 (0.56)	0.89 (0.87)
No	4.62 (2.67)	5.79 (3.17)	0.88 (0.70)	1.05 (0.59)
Compliance (periodontal recall at least every 12 mos.)				
Yes	3.47 (2.41)	3.76 (2.82)	0.67 (0.40)	0.73 (0.55)
No	5.40 (2.29)	5.79 (2.57)*	1.22 (0.74)	1.32 (0.90)

*Statistically significant, as per Wilcoxon rank-sum test, at p-value ≤.05

** Mean percentages of bone loss in total root length, standard deviation shown in parentheses.

Discussion

Mandibular molar teeth studied in this radiographic analysis using ImageJ software exhibited a natural progression of inflammatory periodontal disease in both furcation and interproximal sites. However, bone loss change between sites was not statistically different. The 4.22% bone loss found in the interproximal sites can be roughly translated as a range of 0.56 - 0.63 mm loss over the study period (5.0 to 6.3 years). This assessment translates to an estimated annual interproximal bone loss of approximately 0.09 – 0.1mm based on the average root length reported.[24] Although this is an estimated rate, it is similar to the reported average annual bone loss in chronic inflammatory periodontitis patients.[11, 25-32] No other retrospective radiographic studies analyzing the rate of bone loss in mandibular molar furcation sites versus interproximal sites of the same tooth were found as a comparison to the findings of this study. Additionally, this study did not find significant differences in bone loss between mesial and distal root surfaces or between the first and second molars of the teeth studied. Therefore, no attempt was made to further differentiate between root surfaces or first versus second molars.

Several clinical studies have reported more attachment loss over time in furcation sites versus non-furcation sites.[1,4,13,33] Differences inherent between clinical and radiographic studies can provide some explanation for divergent findings between this study and other investigations and their significance. While clinically evident inflammatory changes of the gingiva may be considered precursors of periodontal destruction, clinical markers of inflammation may not be indicative of bone loss or necessarily lead to bone loss in the future.[34,35] Clinical probing attachment levels may show gains or losses within relatively short periods of time.[4] Due to the nature of a retrospective study, clinical information at and following the baseline was inconsistent or absent, and therefore not included in the current study. A limitation of radiographic studies may be that they indicate less attachment loss than clinical studies because of difficulties and inaccuracies related to identifying the alveolar bone crest projected and overlapped in the tooth furcation area. Radiographs in this study were taken as part of patient assessment records, without any calibrated methods. By necessity, investigators had to include radiographs taken at different angulations in this retrospective sample. This study described bony changes in relation to root length, using sequential periapical radiographs with anatomical landmarks as reference points to measure distances. Two reference points, the anatomical landmarks of the cemento-enamel junction and the tooth apex, were used in attempt to minimize error due to angulation differences.[36] Due to the retrospective nature of this study, the analysis provided, not absolute, but relative proportional measurements.[19,37] Lengths between the furcation to the apex and the interproximal to the apex were calculated and measured separately. Measurements undertaken with use of ImageJ computer software served to minimize the amount of human error in this study.

Another reason for differences in these results versus those found in previous clinical studies, may be the inclusion criteria. While most of the clinical studies cited included teeth with Glickman grade I and II furcation involvement, this study sample was limited to mandibular teeth with radiographically detectable furcation involvement apical to the furcation fornix. This allowed analysis of interproximal and furcation sites without the potential dilution of overlapping radiographic tooth images and alveolar bone based on the established root length. Clinical evaluation and furcation classification were not included in this study due to availability and inconsistent data collection. Additionally, this study did not include any teeth with previous surgical treatment, hence observing natural progression of periodontal disease retrospectively. Despite these limitations statistically significant differences were detected after Bonferroni correction. Some clinically relevant conclusions can be drawn and the results may serve as a basis for further research. Future studies using subtraction radiography could detect density differences over furcation areas and decrease the chances of underestimation of bone loss.[35,37] Utilization of cone beam computed tomography could serve as another instrument to compare the bone volume over furcation areas.

The results from this study indicate that destruction of alveolar bone in furcation sites was significantly greater among the non-compliant group than the compliant group ($p = 0.04$). This finding is similar to previous studies that have addressed progression of periodontal destruction in non-compliant groups and emphasizes the importance of a continuous periodontal maintenance program in controlling the disease process.[7,38] With introduction of power-driven ultrasonic scalers and mini-bladed hand instruments, studies have demonstrated that access in the furcation area is now easier with professional instrumentation.[39] Regular periodontal maintenance care and patient compliance in this study was defined as at least one documented recall visit per year, which is considered to be "low threshold".[38] One visit per year is not an ideal interval for a moderate to severe chronic periodontitis population for whom many authors advocate a periodontal maintenance interval of three to six months.[40] Maintaining frequent periodontal recall is even more imperative for patients with radiographically evident furcation involvement since definitive treatment is not predictable.[1-3] Results in this study demonstrate that even with minimum compliance, periodontal maintenance can influence bone levels in the furcation

area. Compared to regular complier patients, erratic complier patients show high recurrence and more tooth loss.[41] However, Wilson et al.[42] reported that even erratic compliers retain tenfold more teeth than complete non-compliers. Teeth with radiographic furcation involvement may not always be indicated for definitive periodontal surgery. For patients who want to maintain their teeth longer, nonsurgical therapy, even with low threshold frequency, can be an alternative option to minimize the recurrence and progression of the disease.

No significant influences of age, gender, presence of the interproximal restorations, adjacent teeth or edentulous areas or chronic systemic diseases on interproximal or furcation bone loss were identified. A limitation of this study was its small sample size; a larger sample size could help detect differences related to presence of restorations and the other selected variables for possible influences on bone loss. Identifying radiographs in patient records meeting the strictly defined inclusion criteria, did not allow for a larger sample size. The majority of the records were excluded because the teeth had been extracted prior to the five year span required for inclusion in the study. The most common reasons for mandibular molar extractions were presence of periodontal abscesses, mobility or caries. Results from this study question the generally accepted idea that disease progression in furcation sites is more rapid than in interproximal sites. As measured by this study, patient records revealed no more bone loss in furcation areas than in the interproximal areas over time and those who were in the category of minimal compliance (n=14) exhibited less bone loss in furcation areas that those who were categorized as non-compliant (n=4). However, this retrospective study protocol cannot answer the question of clinical significance and whether compliance can help extend longevity for radiographic furcation-involved molars beyond five to six years.Future research, utilizing calibrated clinical and standardized radiographic data, to determine periodontal disease progression in furcation sites is needed.

Conclusion

The findings of this study of mandibular molars suggest a need for further exploration of non-surgical treatment options for molars exhibiting furcation bone loss. Results from this study imply that professionals, who necessarily have better visual and mechanical access to furcation areas than patients themselves, may be able to provide more effective debridement in furcation areas than previously thought. In this study of the five-year records of eighteen subjects, our findings showed no significant differences in the amount of bone loss between the interproximal and furcation sites of non-surgically treated mandibular molars. This conclusion, coupled with a finding that a minimal threshold of a once-per-year compliance with professional care was associated with less bone loss over time, suggests a professional impact on periodontal health beyond what patients alone can achieve through daily home care and personal oral hygiene. Future long-term studies with larger samples, and study designs that standardize radiographic imaging for furcation-involved molars, are warranted.

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ADHA Annual Conference Research Posters

The American Dental Hygienists' Association (ADHA) Annual Conference Research Poster Session provides clinician researchers and educators an opportunity to present their work and exchange information and effective strategies for teaching and mentoring research with their colleagues and other oral health care professionals. The following abstracts were part of the Research Poster Session presented at ADHA's 2016 Annual conference in Pittsburgh, PA.

*Indicates poster presenter

A Survey of Massachusetts Dental Hygienists: Practice Settings, Interest in Educational Advancement, and Career Satisfaction in All Settings.

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Problem: Registered dental hygienists have an obligation to themselves and the community to deliver the highest quality of oral health care. Dental hygienists seek employment in private practice, education, corporations, community health centers, and alternative settings such as nursing homes and schools. Nationally the employment of dental hygienists is projected to grow 19 percent from 2014 to 2024. With increased numbers of dental hygienists entering the workforce, the American Dental Hygienists' Association-Massachusetts seeks to identify demographics, practice settings, interest in professional advancement, and career satisfaction. Survey data obtained can be used to improve the workplace of dental hygienists so they may continue to serve the public.

Objectives: The purpose of this study is to investigate the current landscape including practice settings, interest in educational advancement, and level of job satisfaction of dental hygienists in Massachusetts.

Methodology: This study used a quantitative survey research design with probability sampling. Data was collected using a convenience sample of 50 dental hygienists practicing in Massachusetts. The instrument used in the study contained questions regarding demographics, education levels, years of practice, employment status and settings, office location, hourly wages, benefits, membership in the American Dental Hygienists' Association (ADHA), interest in advancing as a midlevel provider, and career satisfaction of dental hygienists. Survey information was obtained through the use of SurveyMonkey®, and all responses remained confidential. Data was analyzed using descriptive statistics. Statistical analyses were performed using STATA statistical analysis software. IRB approval was obtained from MCPHS University.

Results: Results indicate the majority of dental hygienists who participated in the survey were Caucasian (90%) females (100%) ages 41 to 65 (72%) who are members of the ADHA (70%). Participants initially earned an Associate Degree in Dental Hygiene (86%). Those who pursued higher education (44%) were attracted to personal growth (82%). Less than half of the participants indicated an interest in pursuing a degree to be a mid-level provider (41%). A majority of participants are paid on an hourly basis (80%), treat 8 to 10 patients a day (57%), and earn over $35 an hour (78%). The most prevalent response to all 5-point Likert scale questions regarding personal satisfaction, satisfaction for patient care, and confidence in providing adequate care to patients was "Strongly Agree" (range 45% - 60%).

Conclusions: Results indicate dental hygienists expressed a high level of career satisfaction, an interest in personal and professional growth, and plan for continued employment in the field of dental hygiene. Further research is warranted.

Students' Perspectives Regarding the Health Education Systems, Inc. (HESI) for Dental Hygiene as an Effective Method to Prepare for the NDHBE

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Problem: First time success on the National Dental Hygiene Board Examination (NDHBE) is the goal for every dental hygiene student. Achieving this goal could pose challenges for some students if not thoroughly prepared. Nursing disciplines have been utilizing the Health Education Systems, Inc. (HESI) to benchmark nursing student's first time success taking the National Council Licensure Examination for Registered Nurses (NCLEX-RN).Dental hygiene students do not comprehend the level of preparation required to achieve first time success on the NDBHE. In an effort to prepare dental hygiene students for first time success, a widely used nursing instrument, Health Education Systems, Inc. (HESI) has been introduced for dental hygiene. This testing instruments is affording students a medium to assure preparedness for first time success.

Objectives: The purpose of this study was to retrospectively evaluate student's perceptions and satisfaction with HESI examinations, administered during the final semester of their dental hygiene program, as a method of preparation for the NDHBE.

Methodology: This was a mixed methods research design. A survey instrument was developed based on the literature and contained 19 pre questions and 7 post questions relating to the following areas: demographic characteristics, student perceptions of sense of preparedness and level satisfaction with the HESI preparation materials. The survey was administered to a purposive sample of dental hygiene students (n=29). The pre-survey was disseminated after participants completed four HESI examinations which included:Exit Exam 1 and three specific topic exams. The post-survey was disseminated after completion of the NDHBE. IRB approval was obtained from MCPHS University.

Results: Qualitative and quantitative data was collected utilizing SurveyMonkey®. Qualitative data was collected from the open-ended survey questions, analyzed and coded by researchers to capture common themes. Thematic analysis revealed an overarching theme which noted respondents were satisfied with the HESI as a method to identify content areas the participants did not know and as a review for content previously learned. However the majority believe the HESI needs improvement with content and remediation to be a more useful tool to prepare students for their NDHBE. Additionally, 36% of participants agreed or strongly agreed the HESI examination aided in their preparation for the NDBHE while 48% were either dissatisfied or strongly dissatisfied with the HESI as a board preparation instrument.

Conclusion: Literature regarding HESI Examinations for Dental Hygiene and use within dental hygiene programs is limited. Findings from this study show students are somewhat satisfied however they would supplement with additional study materials. Further research is recommended to determine need for improvements to the HESI to improve student satisfaction and preparedness.

Predictors of Receipt of Dental Procedures by Senior Adults Continuously-Enrolled in Medicaid During Their Transition from Community-Dwelling to Nursing Facility Residences

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Problem: Senior adults in nursing facilities (NF) who access professional dental care might have fewer dental and medical complications than those who do not access dental care. There is limited data available that measured the dental care provided when a senior adult moves from community-dwelling to a NF. It would be valuable to have this data to inform decisions makers and future policy aimed at improving the health of Iowa's NF population.

Objective: To evaluate the predictors of professional dental care utilization when senior adults transition from community-dwelling to nursing facilities.

Methodology: A retrospective longitudinal analysis of Iowa Medicaid claims data was performed. These data were limited to Iowans 68 years or older who entered an Iowa NF and had been continuously enrolled (eligible 58 out of 60 months) in Medicaid for at least three years prior and two years after admission (n=874). A Chi-Square and simple logistic regression was performed. Claims data were used to identify subject level variables including demographics, prescriptions written, chronic conditions diagnosed and dental procedures received. Dental procedures were categorized as ≥ 1 Hygienist Probable Procedure (HPP), Examinations (Exam), HPP and Exam (PDP), or Other procedure per year. Geographic variables were determined by the NF location.

Results: Most subjects did not receive dental care (HPP 76%, Exam 53%, Other 50%) over the 5 year study. Fewer subjects received HPP after NF entry compared to before ($p<0.001$), unlike Exams or Other procedures which increased ($p< 0.001$ each). The

percentage of subjects who received Exams nearly doubled after NF entry (5.3% versus 13.4%); HPP remained at under 0.5% in the same periods.

Controlling for covariates, the odds of receipt of ≥ 1 dental procedure after NF entry were 4.71 times greater for PDP (CI 95% 3.40-6.50) and 3.48 times greater for Other procedures (CI 95% 2.55-4.74) when compared with the odds of those who did not receive the respective dental procedures before NF entry. Controlling for covariates, subjects who resided in an urban NF had 2.00 times greater odds (CI 95% 1.33-3.00) of receiving ≥ 1 PDP and 1.92 times greater odds (CI 95% 1.28- 2.87) of receiving ≥ 1 Other procedures compared to the subjects who resided in a rural NF.

Conclusions: In Iowa, most continuously-enrolled Medicaid senior adults did not receive dental care during the five year study period. More subjects received ≥ 1 dental procedure after NF entry compared to before. Subjects were more likely to receive ≥ 1 dental procedure after NF entry if the subject had ≥ 1 dental procedure before. Subjects were more likely to receive ≥ 1 dental procedure after NF entry if the nursing facility was located in an urban area.

Interprofessional Educational Training Improves Pharmacists' Ability to Counsel Older Adults

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Problem: Pharmacist-based educational interventions provide an opportunity to improve oral health-related knowledge and behaviors for older adults; however, pharmacists may not have received sufficient training to provide appropriate advice.

Objective: The purpose of this study was to evaluate the impact of a training program on practicing pharmacists' (1) knowledge of oral health conditions among older adults, (2) knowledge about interventions to manage oral problems, (3) confidence with ability to locate resources related to oral health, and (4) level of perceived preparedness to counsel older adults about oral health.

Methodology: A convenience sample of practicing pharmacists (n=120) serving older adults was recruited to attend a training program about oral health, and 65 chose to participate. Prior to the program, sixty-two pharmacists ((95%) agreed to complete 2 original, validated surveys: one assessing experiences and training related to oral health, and the other a pre-test to measure knowledge (true/false), ability and level of preparedness with counseling older adults about oral health. A dental hygienist delivered the training program using a combination lecture and small group discussion format. Immediately afterwards, 62 participants completed the validated matching post-test. Responses were anonymous to protect confidentiality. Data were analyzed using SPSS 22 (IBM Corp. Armonk, NY). Responses to the first survey were reported using descriptive statistics. Pre-test and post-test data were compared using the McNemar test and Wilcoxon signed-rank test.

Results: Forty-two percent of pharmacists received some formal training about oral health in school (n=26). An exact McNemar's test determined that there was a statistically significant difference on 5 of the 12 knowledge measures ($p = 0.000$) after the training intervention. A Wilcoxon signed-rank test showed that participation in the training program produced a statistically significant change in pharmacists' confidence in ability to locate oral health information ($Z = -5.197$, $p = 0.000$) and available area dental resources ($Z = -5.202$, $p = 0.000$); and level of preparedness to counsel older adults about the importance of oral health to overall general systemic health ($Z= -5.847$, $p = 0.000$) and about interventions to address oral health needs ($Z = -6.026$, $p = 0.000$).

Conclusions: Older adults seek advice from pharmacists about oral health and oral care products. Participation in an interprofessional training program improved pharmacists' knowledge, confidence in ability to locate resources, and level of preparedness to counsel older adults about oral health. A.T. Still University IRB approval #2015-068. Funding source: Dental Trade Alliance Foundation

The Effect of Magnification Loupes on Posture During Instrumentation by Dental Hygienists

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Problem: The physical stress of clinical practice is an occupational risk factor for developing musculoskeletal disorders (MSD) in dental hygienists. The utilization of dental magnification loupes shows a great deal of promise in decreasing neck flexion and improving posture.

Objectives: The purpose of this study was to determine the effects of dental magnification loupes on posture during instrumentation.

Methodology: A convenience sample of twenty-seven right-handed dental hygienists with no history of injuries or disabilities of the head, neck, and trunk regions was enrolled. Baseline posture calibration was taken. Accelerometers were placed on four locations of the head and trunk (head, cervical vertebrae: C5, thoracic vertebrae: T5, lumbar vertebrae: L1) to measure changes in posture. Accelerations in three axes were recorded (anterior/posterior (AP), medial/lateral (ML), vertical (VT)). Mean accelerations of these axes were used to compute average forward tilt (APangle) and sideways tilt (MLangle) of each sensor. For each axis, root mean square (rms) was calculated to determine magnitude of tremor fluctuations (APrms, MLrms and VTrms). Paired sample t-tests were performed to assess differences in the dependent variables (APangle, MLangle, APrms, MLrms, VTrms). Chair mounted typodonts with artificial calculus represented a simulated oral environment. Subjects were randomly assigned to wear loupes during the first or second half of the experiment and instructed to explore all areas of the mouth with an ODU 11/12 instrument. Chi-square was used to analyze survey questions.

Results: Twenty seven participants (26 female and 1 male) completed the study. Results revealed no statistically significant differences between loupes and no loupes in the tilt angle of each sensor location in the AP or ML planes. In contrast, a statistically significant difference in mean fluctuations while wearing loupes (M=.215152, SD=.0741530) (rms) in AP at C5; $t(24)=2.63$, $p=.015$, compared to not wearing loupes (M=.261028, SD=.1379292) indicated posture fluctuations decreased while wearing loupes. APrms was only significant at C5; for ML and VT axes and sensor positions (head, C5, T5, L1) there were no statistically significant differences in mean fluctuations (rms) between wearing loupes and not. Overall, 74% of participants strongly agreed magnification loupes made instrumentation easier and 67% of participants strongly agreed magnification loupes improved their posture.

Conclusions: While participants perceived that magnification loupes enhanced their posture, the study provided little evidence that wearing loupes leads to changes in body orientation; only to reduced postural tremors at C5 in the AP axis.

Factors that influence purchasing decisions by clinical dental hygienists – Product testing, purchasing, and ergonomic considerations

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Problem: Post-graduation product purchasing decisions are not well documented. Little is known about how hygienists gain information about new products, what factors influence testing a product or encouraging a product purchase and whether ergonomic awareness and education plays a role in purchasing.

Objectives: To examine post-graduation purchasing practices:

- Determine how hygienists learn about new products
- Learn what encourages hygienists test new products
- Understand the factors that motivate product purchasing
- Explore if ergonomic awareness and education impact purchasing decisions.

Methodology: Hygienists were invited, via multiple social media sites, to participate in the voluntary, convenience poll. Data was collected using an online, internet-based convenience sample over a three-week period in November 2012. The survey instrument contained 23 close-ended, pilot-tested questions including: basic demographics, academic training about WRMSD, new product information sources, factors influencing product testing and purchasing. Responses were confidential. Data was analyzed using descriptive statistics.

Results: A total of 1,217 licensed dental hygienists representing 47 states and 6 Canadian provinces responded. The top learning resources were magazine articles (78%), CE course content (77%) and professional recommendations (70%).

Seventy-two to 88% of those practicing for more than one year learned about new products through CE courses, in contrast to 48% of new graduates. Hygienists practicing more than one year used a wider range of learning opportunities than recent graduates ($p<0.01$). Platforms included magazine articles, clinician recommendations, advertising, CE courses, exhibit halls, online manufacturer communication, and company programs.

Testing new products is driven by free samples (81%), evidence-based research (65%), and clinician recommendations (53%). New graduates were most likely to absolutely consider evidence-based research (74%). Purchasing decisions were driven by quality/durability (84%), saving time (79%), infection control ease (70%), and ergonomic benefits (69%).

Hygienists with <1-10 years of practice were more likely to make purchasing decisions based on ergonomic benefits than other cohorts, with 76% reporting ergonomics absolutely influenced purchasing decisions ($p<0.05$). Seventy percent of those practicing 31 plus years considered ergonomic benefits an absolute motivator. Ninety-two percent of those in the <1 year cohort who learned about ergonomics in school reported ergonomic benefits absolutely motivated their purchasing decisions, versus 42% for who did not learn about ergonomics in school.

Conclusions: Despite varying practice lengths, dental hygienists appear to have consistent behaviors regarding how they learn about, test and purchase new products. Ergonomic benefits were most important to early-career clinicians and those practicing three decades or more. Further research should focus understanding how hygienists incorporate product purchases in their professional careers.

Dietary Habits during Pregnancy: A Self-reported Evaluation of the Intake of Sweets and the Role of Dental Hygienists in the Prevention of Oral Health with Pregnant Women

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Problem: Proper oral healthcare during pregnancy is essential for the promotion of both oral and systemic health of mothers and newborns; nutritional requirement of pregnant women requires optimal intake of carbohydrates to prevent diabetes and dental diseases. Mothers often receive poor preventive guidance about nutrition and oral health care.

Objectives: With the aim to find any potential relationships, this study analyzed the intake of sweet foods during pregnancy, smoking and alcohol habits, oral hygiene tendencies, the frequency of dental visits and oral health status in a cohort of postpartum women.

Methodology: A cohort of 410 consecutive postpartum women were surveyed at the obstetrics/gynecology clinic of the University of Milan. Trained dental hygienists interviewed with a customized questionnaire and examined the patients at bedside within 5 days from delivery, performing a full oral examination. The informed consent was signed before the examination. Data collection included the socioeconomical status, daily diet characteristics and sweets intake, smoking, oral hygiene habits, oral symptoms during pregnancy; dental (DMFT) and periodontal clinical indexes were recorded. Descriptive statistics and relevant associations were analyzed with JMP 9.01 software performing ANOVA and nonparametrical tests.

Results: The women were aged from 19 to 47 years (mean 32.9, IQR 30-36); 31.5% reported graduate education, 66.8% high school education and 7% primary school education. 62.4% of the subjects never smoked while 37.6% were former or current smokers. 71.1% of the subjects reported an intake of sweets at least once a day. 53.6% of women brushed their teeth twice a day after meals. 34.8% reported that they see the dentist only for emergencies and 65.2% had a professional prophylaxis at least yearly.79.7% of the women had at least one oral/dental symptoms during pregnancy: gingival bleeding, tooth mobility, bad breath. Mean bleeding on probing (BOP) index was 9.7 (14.5 st.d.; 0.9-12.5 IQR). Mean DMFT was 7.6 (4.1 st.d.; 5-10 IQR). The statistical analysis highlighted the following main associations: oral pregnancy symptoms were slightly higher in smokers: BOP was higher in smokers ($p=0.03$); mean DMFT was slightly higher with a daily intake of sweets with low statistical significance ($p=0.08$).

Conclusions: The study demonstrated the existing associations between these risk factors and oral diseases during pregnancy and how the dental hygienists may play a crucial role in prevention and advocacy.

Cultural Adaptability of Dental Hygiene Program Directors in the United States

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Problem: Diversity of the workforce is increasing in oral healthcare as well as the patients that are served. As diversity increases, dental hygiene programs must support and promote diversity initiatives that will drive programs and policy that ensure all individuals are equally and effectively supported within their work environment. Dental hygiene program directors need to be aware of their own cultural adaptability to be able to support, nurture, and lead a culturally competent workforce.

Objectives: This study utilizes institutional theory to build the basis of the study to evaluate the cross-cultural adaptability of U.S. Dental Hygiene program directors. By identifying factors of cross-cultural adaptability among dental hygiene leaders,

future theoretical models can be examined that will strengthen leadership capability for development of leadership models and leadership competencies in the dental hygiene profession.

Methodology: The Cross-Cultural Adaptability Inventory™ (CCAI) and a survey questionnaire were administered to a randomly stratified sample of dental hygiene program directors in the U.S via USPS (N=250) with a 38% response rate (n=94). The CCAI evaluated measures of cross-cultural adaptability including emotional resilience, flexibility/openness, perceptual acuity, and personal autonomy. The directors were also surveyed on their years of service as a program director, extent of diversity training, and to what extent their organization identifies diversity as part of its strategic goal. Data were analyzed utilizing frequencies, percentages, means, and logistic regression.

Results: Results of the regression analysis revealed that there was no significant relationship between the years of experience as a dental hygiene program administrator as is relates to emotional resilience, F (1, 91)=.94, p=. 34 > .05, flexibility/openness, F (1, 91)= .22, p= 0. 64 > .05, perceptual acuity, F (1, 91)= .00, p= 0. 41 > .05, and personal autonomy F (1, 91)= .00, p= 0. 98 > .05. Independent t-test analysis for differences determined there was no significant relationship between institutional strategic planning as is relates to emotional resilience, t (89)=-1.48; p= 0.14 > .05, flexibility/openness, t (89)=-0.6; p= 0.95 > .05, perceptual acuity, t (89)=-0.62; p= 0.54 > .05, and personal autonomy, t (89)=-0.26; p= 0.80 > .05. Regression analysis determined a statistically significant relationship of diversity training among program directors and the areas of emotional resilience, F (1, 91)= 6.94, p= .01 < .05, flexibility/openness, F (1, 91)= 7.32, p= .01 < .05, and perceptual acuity, F (1, 91)= 5.3, p= .02 < .05 and rejected the relationship in the area of personal autonomy, F (1, 91)= 1.33, p= 0.25 > .05.

Conclusion: The study confirms that dental hygiene program directors adapt well and demonstrate tolerance cross-culturally. The study also proved that the majority of colleges and universities support diversity through their strategic plans, which may influence the cross-cultural competence of dental hygiene program directors. This study illuminated an understudied aspect of dental hygiene academia, which is that of the largely female gendered profession, its effect on personal autonomy of dental hygiene educators, and its influence on the development of leadership within the dental hygiene profession.

Implementing Training in Screening and Brief Intervention for Alcohol, Tobacco, and Other Drug Use (ATOD) to Facilitate Interaction and Improve Patient Care Outcomes

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Problem: The dental hygiene care setting presents a unique opportunity to implement screening and brief intervention for alcohol, tobacco and other drug use as part of a dental health screening. Teaching these skills to dental hygiene students presents an opportunity to provide enhanced safe, effective and comprehensive care.

Objectives: The objective of this project was to educate dental hygiene students on how to screen and intervene with patients who present with alcohol, tobacco, or other drug use. This model expanded the familiar concept to of tobacco screening and education to include alcohol and other drug use.

Methodology: Dental hygiene students (n=85) participated in an educational and practice session, to learn the model and apply the skills with standardized patient scenarios. Students completed the Alcohol and Alcohol Problems Perceptions Questionnaire (AAPPQ) and Drug and Drug Problems Perception Questionnaire (DDPPQ) at three time points. Dependent variables were Role Security, defined by acceptance of the appropriateness of screening and intervening with patients, and Therapeutic Commitment, defined by motivation and likelihood of changing behavior. Data were analyzed using within-subjects, repeated measures ANOVA. Students' SBIRT skills were rated by faculty and peers using a Competency Rating Scale during the practice session. This project was determined as exempt by the University of Pittsburgh Institutional Review Board.

Results: For both AAPPQ and DDPPQ, the overall F-value for the Role Security subscale was significant. For AAPPQ, $F(2,44)=16.48$, $p<0.01$, and for DDPPQ, $F(2,46)=7.42$, $p<0.01$. Overall Therapeutic Commitment scores did not increase significantly across the three time points on either the AAPPQ or DDPPQ. Increases in Role Security were accounted for by pre-education to post-education differences. For AAPPQ, $F(1,22)=24.16$, $p<0.01$), and for DDPPQ, $F(1,23)=6.96$, $p=0.01$. For Therapeutic Commitment, while the overall time effect was not significant, an increase was observed between the education and practice sessions. For AAPPQ, $F(1,23)=8.22$, $p<0.01$, and for DDPPQ, $F(1.24)=7.38$, $p=0.01$. Simulation competency ratings showed that students learned and applied SBIRT skills with standardized patients.

Conclusions: These results indicated that SBIRT education and practice contributed in unique ways to students' perceptions and attitudes about working with patients with alcohol and other drug issues. The educational session was associated with increased Role Security while the practice session was associated with increased Therapeutic Commitment. Students can now integrate the SBIRT model during the assessment phase of their dental hygiene care appointments.

Laser Education in Dental Hygiene Baccalaureate Programs

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Problem: Lasers are being used in many states by dental hygienists; but, uncertainties concerning laser usage and educational requirements may be deterring their use.

Objective: Dental lasers are increasingly utilized by dental hygienists as an adjunct to periodontal therapy to eliminate pathogens remaining in a gingival pocket following scaling and root planing. The primary objective of this study was to examine the inclusion of dental laser curriculum in baccalaureate dental hygiene programs. The secondary objective was to assess the inclusion of lasers in dental state practice acts across the nation.

Methodology: An electronic survey was sent to all baccalaureate dental hygiene program directors (N=55) across the U.S. to assess inclusion of dental lasers in their State practice act, as well as the didactic and clinical curriculum offered at their perspective institutions. This study was approved by the Institutional Review Board of the University of Maryland, Baltimore. Information was obtained anonymously, and voluntary completion of the questionnaire was taken as informed consent to participate in the study. The survey was sent December 2014 and again in March 2015 to increase subject participation. The instrument included eight questions, and descriptive statistics were used to analyze the data collected.

Results: Surveys were completed by twenty-nine of the fifty-five program directors, for a response rate of 52.7%. Analysis of the survey instrument indicates nearly half 48% of those who responded do not have laws governing "lasers" in their State practice acts. While 38% of respondents include a didactic overview of lasers in their entry-level programs the majority (90%) do not include a certification or hands-on course. Hours of study varied from 1 to 15 hours. Only two schools responded that they offer a laser course to degree completion students.

Conclusion: Suitable laser education may assure a better understanding of proper usage and safety in clinical applications. The dental hygiene profession is constantly advancing; clarity of language in state practice acts to include "laser," with standardized guidelines and requirements may increase utilization of dental lasers by registered dental hygienists leading to improved patient care and outcomes. The current laser education curriculum may defer due to state practice acts not evolving as rapidly.

Oral Health Status of Independent Older Adults in Texas: An Observational Study of the Urban/Rural Areas of Central Texas

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Problem: Currently, there is no data on the oral health needs of the older adult population in Central Texas. This assessment of the oral health conditions of seniors participating in congregate meal centers throughout the Austin-metro area will provide information about the oral health needs of the older population.

Objectives: To determine the oral health needs of the community-dwelling older adults participating in congregate meal centers and evaluates differences in oral health needs between the urban and rural communities.

Methodology: This observational, cross-sectional study evaluated subjects form 3 urban and 3 rural congregate meal centers around Austin, Texas. Participants were a convenience sample of community dwelling older adults 65 years and older participating in meal congregate services (n=78). A self-report, modified survey questionnaire was completed by the participants followed by oral health screening performed by two calibrated examiners utilizing the Association of State and Territorial Dental Directors Basic Screening Survey for Older Adults. Descriptive statistics were used to describe the differences between the demo-graphic characteristics and oral health conditions of the participants. A chi-squared test of independ-ence was utilized to analyze the questionnaire data and oral health assessment data to explore relation-ships between the variables.

Results: When comparing urban and rural community participant report of pain in the last year, there were no significant differences in oral health condition between the urban and rural communities (p=0.788). Fifty percent of participants had incomes below $15,000 and reported no dental insurance coverage to pay for all or a portion of dental care (n=64.9% urban; n=56.1% rural; p=0.58). Eighty-seven percent re-ported tooth loss due to dental caries, untreated dental caries (48.6% to 56.1%; p=0.824), 35% (p=0.269) required periodontal care, and 37% to 43% (p=0.908) reported painful aching in their mouth in the last year either very often or occasionally.

Conclusions: Oral health prevention is an emergent need for the older adult population residing in urban and rural communities to address untreated dental disease. Analysis revealed the majority of the populations in both urban and rural areas of Central Texas have financial and socioeconomic barriers to access preven-tative and restorative dental care services.

Use of Concurrent Online Courses to Socialize Students to Research and Scientific Writing

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Problem: Scholarly inquiry and research is a core competency for dental hygiene graduate education. However, integrating research concepts in scholarly writing is a common challenge for graduate students in the online learning environment.

Purpose: The purpose of this study was to assess a cohort of first year dental hygiene graduate students' perceptions on a new curricular model using concurrent online course sequencing to socialize students research and scholarly writing.

Methods: This pilot study design assessed two graduate online courses taught concurrently with content developed to provide students with a global rather than linear approach to the research process and thesis development. Graduate dental hygiene students (N=6) in their first year were enrolled in a traditional Research Methodologies and Scholarly Writing course with weekly topics in line with elements of thesis prospectus development, Annotated Bibliography and Literature Review. Concurrently, an Introduction to Thesis course provided these students with content on use of electronic citation management software, personal appointments with the course director to brainstorm thesis topics, assignments in prospectus development, orientation to the Internal Review Board (IRB) process, Collaborative Institutional Training Initiative (CITI) Certification, and APA formatting resulting in students selecting graduate thesis committee members, developing a thesis learning agreement, an approved prospectus, and a formatted first draft of thesis.

Results: Descriptive statistics analyzed individual score items as well as the total scores. Using a 5-point Likert-type scale (0 = strongly disagree to 5 = strongly agree), participants (n=3) rated their level of agreement on a 9-item questionnaire.

A response rate was 50 percent (n=3). A mean score of 4 (somewhat agree) was reported on 7 of the 9 items. These items were related to concurrent course delivery in developing the prospectus, coordination of assignments, sequencing topics; applying concepts and engaging in the thesis process, finding direction in research, and facilitating learning. Of the respondents, 33 percent (n=1) stated completing the Research Methods course prior to enrolling in the Introduction to Thesis course best facilitates learning. Overall, respondents agreed completing the Research Methods and the Introduction to Thesis courses concurrently bests facilitates learning (n=2; 66%).

Conclusions: The use of concurrent courses in online course delivery demonstrates an effective curricular model in socializing graduate dental hygiene students to research and scholarly writing.

Service Learning and Cultural Awareness in Belize

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Problem: The purpose of this program was to provide preventive oral health services to underserved people in Belize. Program goals were to treat people who do not have regular access to oral health care, to provide students the opportunity to participate in a culturally diverse outreach program, and to increase student's competency in providing oral health services.

Significance: Integrating service-learning with a culturally diverse population into dental hygiene curricula fosters graduates who are better prepared to work effectively among diverse populations and have the opportunity to learn beyond what could be achieved in the classroom.

Key features: Dental hygiene faculty at Minnesota State University, Mankato collaborated with dentists in Belize to establish a service-learning rotation in San Pedro, Belize, located on the island of Ambergris Caye. During their final semester in the program, senior dental hygiene students participated in this optional, seven-day study abroad experience. Prior to departure, the students acquired knowledge concerning the culture of Belize, healthcare standards and protocols, and what the anticipated experience providing oral health care in Belize would involve. Fourteen students, four dental hygiene faculty, and three dentists volunteered at two clinics in San Pedro to provide oral health care for adults and children. Treatment included amalgam and composite restorations, prophylaxes, radiographs, sealants, fluoride varnishes, and oral hygiene instructions. Dental hygiene students also visited elementary schools, applying fluoride varnish to over 500 children, along with providing oral hygiene instructions. While in Belize, students were immersed in the Belizean culture as they explored the island and traveled to the mainland of Belize to experience various geographic areas of the country.

Results: Students wrote daily reflection papers to evaluate their accomplishments, reflect on their experiences providing oral health care, and document their cultural experiences during travel. Reflections were positive, indicating greater confidence in dental hygiene skills, awareness of cultural diversity, and a desire to be involved in outreach projects as they begin their professional careers. Service learning in cultural diverse populations enhances dental hygiene education and can be an integral part of the curriculum.

Registered Dental Hygienists' Interest on Entry into the Field of Dental Hygiene Therapy in the State of Maine

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Problem: In the spring of 2014, the Maine state legislature enacted a new law, LD1230, establishing a midlevel oral health care provider, the Dental Hygiene Therapist (DHT). The DHT was created to address the state's access to oral health care issue, with the scope of practice for the Maine DHT including preventive oral health care services, routine restorative treatment and simple extractions. Despite state legislative efforts to bring this licensed dental provider into reality, no dental therapy academic programs currently exist in New England. Additionally, the level of knowledge among Maine registered dental hygienists (RDHs) regarding the DHT and interest in enrolling in a DHT program was unknown.

Objectives: This study was conducted to assess the awareness of Maine RDHs regarding this new oral healthcare role, and to gather information regarding their degree of interest in enrolling in a DHT program.

Methodology: The study used a quantitative cross-sectional design with a non-probability purposive sampling of RDHs in Maine. The state licenses approximately 1,420 RDHs, and of these 1,284 were contacted via e-mail and invited to participate in the survey. The study was approved by the university's Institutional Review Board. Web-based survey software was used to collect data over a three week period with a questionnaire consisting of nineteen survey items, including eight demographic questions, Likert-type scale questions, multiple choice questions, and optional open-ended questions. Descriptive statistics were used to analyze the data collected.

Results: Two hundred sixty-eight of the Maine RDHs invited to participate responded and completed the electronic questionnaire. The response rate for the survey was 21%. Ninety-eight percent of those who responded were female, and the majority of participants were Caucasian (95%). Two hundred and thirty-two (87%) of the participants were aware of the law enacting the DHT as a provider in Maine, while 175 (66%) expressed interest in enrolling in a DHT program; 107 (61%) of respondents stated willingness to enroll in a DHT program within the coming year.

Responses to the open-ended questions revealed the majority of RDHs saw a need for this new provider role with statements such as, "I believe it would be a great idea to implement this program to provide dental care to places that are underserved."

Conclusions: The study outcomes indicate interest exists among Maine RDHs regarding entry into the DHT provider role and enrollment in a DHT program. Although no DHT programs exist in the New England states, this study suggests student enrollment would be sufficient to support the establishment of a DHT program.

Perception of Dentists, Dental Hygienists and Patients towards the Dental Hygiene Profession in Delhi, India

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Problem: Dental hygienists are licensed auxiliary dental professionals. With existing population and oral health conditions there continues to be a shortage of active dental hygienists in India. The scope of dental hy-gienists' practice is also ambiguous in India. It is unclear to what extent is the role of dental hygienists in oral care and whether they are shared by hygienists and dentists. Role play of the profession in dominant hygiene model of care confined within dental practice in India is a grey area.

Objectives: To know the perception of dentist's and dental hygienists in Delhi, India about the role, re-sponsibilities, barriers and work environment of dental hygienists in Delhi as well as to know the aware-ness of patients about dental hygienists.

Methods: This cross sectional study was conducted on a purposive sample of 80 dentists and 40 dental hygienists among all (n=4) dental Institutions in Delhi. Convenience sample of 100 patients visiting the dental institute were interviewed regarding awareness of dental hygienists by using 10 questions. A for-mat along with self administered questionnaire was designed consisting of both open and closed ended questions. There were a total of 32 questions for dental professionals and 39 for dental hygienists under the domains: socio-demographic profile, knowledge of dental hygienist role and responsibilities, atti-tude and barriers. The questionnaires were subjected to expert's validation and 10% of the sample in each category was used for reliability analysis. The data was analyzed in SPSS and subjected to descriptive analysis and chisquare test.

Results: 89.6% of patients were not aware of dental hygienists and their roles. 62% of dentist`s and 32% of dental hygienists response was "yes" for the role of dental hygienist limited to oral prophylaxis (p=0.03,S). 40% of dentists and 83.5% of dental hygienists were not aware of the concept "four handed dentistry"(P=0.001,S). Majority of dentists (73.7%) rated working environment as "good" for dental hy-gienists when compared to dental hygienists (82%) who rated "low" (p=0.002,S). Financial barrier was high among dentists where as it was the Legislation and dentists acceptance for dental hygienists.

Conclusions: In conclusion our study showed that there is disparity between dentists' and dental hygienists' perception of dental hygienists' roles, responsibilities and working conditions. The dental team approach concept is lacking India as per the views of both the professions. Patients should be made aware of this profession and asked for preference of treatment.

Patient Attitudes Regarding Salivary Genetic Biomarker and Periodontal Pathogen Testing

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Problem: Specific periodontal pathogens present in the oral microbiota, such as P. gingi-valis, T. forsythia, and P. intermedia, are found to be indicative of susceptibility to periodontal destruction. According to a recent study on patient stratification and preventive care in dentistry, a personalized approach combining genetic bi-omarkers and conventional risk factors provides better outcomes for patients. There is currently no literature describing patient attitudes towards such sali-vary diagnostic testing for risk assessment and management of periodontal dis-ease.

Objectives: The purpose of this study was to determine patient attitudes regard-ing salivary diagnostics to identify both genetic and pathogenic risks for perio-dontal disease. The aims of this study were to assess (a) patient attitudes to-wards salivary testing for periodontal risk factors via genetic biomarkers and periodontal pathogens, (b) patient attitudes toward paying for such risk assess-ment testing, and (c) whether or not patients felt positive results would impact their overall oral health care and treatment compliance.

Methods: An 18-question, paper survey was developed, and piloted. The survey was determined to be exempt by the University of Michigan (UM)

Institutional Review Board HUM00094305. A convenience sample of adult patients aged 18 and over at the UM School of Dentistry were recruited for participation. Descriptive statistics were computed to provide an overview of the responses.

Results: A total of 192 surveys were collected. While one quarter of respondents would only undergo testing if insurance covered the cost, one third of respond-ents indicated they would be willing to pay up to $100 out of pocket for testing, while another 8% were willing to pay up to $200. Additionally, 78% of patients said they would change their oral health care based on positive results, and 81% felt they would be more compliant with treatment, recall and home care recommendations. There were no significant correlations between education or income, and patient willingness to undergo testing, pay out of pocket for the testing, or changing compliance behavior.

Conclusions: This study indicates that patients were interested in undergoing salivary diagnostics for periodontal risk assessment and management. Out-of-pocket cost does not appear to outweigh the benefit of specific, personalized risk assessment. The personal specificity salivary diagnostics offer may be a potentially influential risk management tool to improve patient outcomes. Future stud-ies should include a wider assessment of patient attitudes towards the use of salivary diagnostics for periodontal risk management.

Hookah Smoking: Assessing College Students' Behaviors, Attitudes, and Knowledge

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Problem: Hookahs are waterpipes in which tobacco is heated, passed through water, and then smoked through a hose and mouthpiece. Hookah smoking among high school and college students has become a popular trend in recent years. Many students find hookah smoking to be socially acceptable, however, they have little knowledge on the overall impact to their general and oral health.

Objectives: The objective of this study was to assess college students' behaviors, attitudes, and knowledge regarding hookah smoking.

Methodology: This study was conducted at a Midwest university and used a convenience sample of 204 students from various majors. Respondents were asked about their past, current, and future hookah smoking behaviors. Likert-scale questions were used to assess attitudes regarding hookah smoking. Last, they were asked ten questions regarding the history and health effects of hookah smoking. A knowledge score was calculated based on the number of questions answered correctly. Survey data was analyzed using independent sample t-tests and a one way ANOVA test at a significance level of $p<0.05$.

Results: Sixty-eight percent of respondents have participated in hookah smoking in their lifetime with first time use ranging from 14 to 21 years of age. In the last thirty days, 31.8% have participated in hookah smoking. The majority (68%) stated that they will no longer be participating in hookah smoking in five years. Over half of the respondents reported that it is socially acceptable to participate in hookah smoking and 43% reported that hookah smoking has relaxation benefits. The overall mean knowledge score was 4.4 questions correct out of 10. There was a significant difference ($p=.044$) in the mean knowledge scores between the age group of under 19 (3.3) and the age group 20 to 21 (4.68). When comparing allied health and nursing majors to all other majors, the allied health and nursing group scored significantly higher ($p=.017$) than the non-allied health and nursing majors with means of 4.7 and 3.8. Forty percent of the respondents were unaware that hookah tobacco and smoke can cause oral cancer.

Conclusions: Based on the low knowledge scores, this research supports that more education about hookah smoking and its health consequences is needed. Improved awareness and knowledge of hookah smoking for dental hygienists could be achieved through continuing education and integration into dental hygiene program curriculum.

Exploring Student Satisfaction Among Students Enrolled In A Dental Hygiene Program Utilizing Synchro-nous Distance Education

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Problem: Distance education has been used by many educational institutions for years, but the use of synchronous distance education (SDE) is still new to many. Though approximately 66% of institutions have realized an increase in the demand for distance learning offerings, research related to SDE is limited. The problem is that educators can find a substantial amount of information and statistics referencing the broad topic of DE, but very little data is available to them in regard to SDE and student satisfaction.

Objective: This research aimed to evaluate student satisfaction among SDE classes on two separate campus sites in order to add to existing literature referencing SDE.

Methodology: This longitudinal case study took place from June 2014 through September 2015. Participants included a convenience sample of SDE dental hygiene (DH) students (n=122) with a response rate of 95%. MCPHS University IRB approval was obtained in May of 2014. Student perceptions of SDE versus traditional classroom experiences and characteristics related to SDE were measured using validated pre-and post-program surveys. The 40-question surveys were distributed using a web-based tool and participant identities remained confidential. Data were analyzed using parametric univariate and multivariate regression methods

Results: Univariate linear regression showed no difference in student perceptions of SDE pre-course vs post-course, nor did multivariate linear regression controlling for student cohort. Regression results showed the fall cohort had a more positive perception of SDE than the summer cohort ($p<0.001$), furthermore, the multivariate linear regression reporting on characteristics related to SDE were overall positive in magnitude ($p=0.347$), with the fall cohort reporting significantly more positively than the summer cohort ($p<0.001$). Results indicate, at an alpha threshold of 0.05, there is a significantly higher level of satisfaction with SDE overall for the fall 2014 cohort than the summer 2014 cohort ($p<0.001$).

Conclusions: The results support previous research indicating that students acclimate to different means of course delivery; however, it also shows that institutional support as well as student and faculty familiarity with SDE technology are significant influences on student satisfaction. Results are intended to aid educators in recognizing these influences which impact student satisfaction and help to bridge the gap in the literature referencing SDE. More research needs to be done comparing SDE to face to face instruction and use of class moderators.

Dental Consumer's Perceptions of Dental Hygienists with Visible Tattoos

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Problem: One in five United States adults have a tattoo and negative stereotyping of individuals displaying tattoos is a well-documented cultural norm. The growing trend of body art is regarded as the right of self-expression, with 4 out of 10 young people having a tattoo, yet the conflict between self-expression and professionalism in health care and dentistry exists.

Objective: The purpose of this study was to survey dental patients in the United States to assess their perceptions of dental hygienists with visible tattoos.

Methodology: An 11 item investigator-designed survey was administered online via a commercial web based software company (www.surveymonkey.com) to adult members of Amazon's Mechanical Turk (MTurk) (https://www.mturk.com/mturk). The survey was made available to United States MTurk members based on three qualifiers: English speaking, at least 18 years of age, and have visited a dentist within the last 60 months. Respondents received a nominal fee to complete the survey (50 cents). Two hundred and three acceptable electronic surveys were completed and returned by dental consumers in two hours. Surveys were randomized according to respondents' birth month. Participants viewed one of three photographs of the same dental hygiene model wearing short sleeved scrubs without a tattoo, a small tattoo on the hand or a large sleeve tattoo on the arm. Participants scored each photograph on a 5-point Likert scale regarding how ethical, responsible, hygienic, competent and professional the individual in the photograph appeared. Completed surveys were analyzed for response frequency. One way analysis of variance (ANOVA) was used to compare the means for each of the tattoo conditions. If significant interactions occurred, Tukey's post hoc test were used to locate significant differences. Independent Samples T Test were also used to compare differences by age and gender. Significance was set at the .05 level.

Results: Most respondents (88%) in the no tattoo group rated the model as professional, although, only 49% of respondents rated the model with the sleeve tattoo as professional. Overall results reveal respondents rated all five attributes higher for the dental hygienist with no tattoos (M=4.28), and lowest for the sleeve tattoo (M=3.55) model. When comparing the three groups, respondents are less likely to use a

dental office where the dental hygienist has a sleeve tattoo (p = .000) and are more likely to refer others to a dental office where the dental hygienist has no tattoos (p = .000). Whether a participant has a tattoo had no significant effect on overall attribute mean scores. The sleeve tattoo model was scored significantly lower in the over forty age group (p = .019). Gender had minimal effects on results, although females respondents are more likely to refer others to a dental office if the dental hygienist has a small tattoo (p = .029).

Conclusions: Results suggest small tattoos are perceived by dental consumer as acceptable in the clinical setting; however, the larger sleeve tattoos are less accepted by dental consumers. These findings provide evidenced based information on visible tattoos that educators can use when making decisions about appearance and dress code policies, and provide insight for educators preparing individuals to enter the workforce as they contemplate decisions about obtaining body art.

Framing Young Children's Oral Health: A Participatory Action Research Project

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Problem: Despite the widespread acknowledgment of the importance of childhood oral health, little progress has been made in preventing early childhood caries, an important public health problem. Survey-based studies have reported factors such as parental education, dental neglect and lack of access to care as barriers for the adoption of optimal child oral health related behaviors. However, our knowledge is limited regarding specific daily-life and community-related factors that impede optimal oral hygiene, diet, care, and ultimately oral health for children.

Objective: We sought to address this knowledge gap by gaining insight into what parents of young children themselves consider as important, potentially modifiable factors and resources influencing their children's oral health, within the contexts of the family and the community.

Methodology: This qualitative study employed Photovoice, a community-participatory action methodology. Participants were a convenience sample of 10 English-speaking parents of infants and toddlers, residents of Durham County in NC and clients of the federal Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The primary research question posed to participants was: "What do you consider as important behaviors, as well as family and community resources to prevent cavities among young children?" Five group sessions involving discussion of participants' photos, community maps and emerging themes were conducted. Sessions were recorded, transcribed verbatim and analyzed using qualitative research methodology. Inductive analyses were based on analytical summaries, double-coding, and summary matrices and were done using Atlas.ti.7.5.9 software.

Results: Good oral health was associated with avoidance of problems or restorations for the participants. Financial constraints reportedly affected healthy food and beverage choices, as well as access to oral health care. Time constraints and occasional frustration related to children's oral hygiene emerged as additional barriers. Establishment of rules/routines and commitment to them was a successful strategy to promote their children's oral health, as well as modeling of older siblings, cooperation among caregivers and support by friends, family and the social circle. Community programs and organizations, social hubs including playgrounds, grocery stores and social media emerged as promising avenues for gaining support and sharing resources.

Conclusion: Low-income parents of young children are faced with daily life struggles that interfere with oral health and care. Financial constraints are pervasive, but parents identified several strategies involving home care and community agents that can be helpful. Future interventions aimed to improve children's oral health must take into consideration the role of families and the communities they live in.

An Investigation of Underrepresented Minority Students in the Dental Hygiene Profession

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Problem: There is a lack of ethnic and racial diversity in the dental hygiene profession across the United States. Recruitment efforts have been ineffective in increasing the number of underrepresented minorities (URM) in the profession. There is a lack of empirical evidence in the literature that examines the experiences and opinions of URM in the dental hygiene profession using qualitative methodology.

Objectives: This study explored what factors motivate URM individuals to enter the profession of dental hygiene and their experiences in the profession. Understanding the reasons for choosing dental hygiene and the career experiences of URM is imperative to improving recruitment efforts. This study sample included URM dental hygienists in Ohio and Pennsylvania.

Methodology: This descriptive mixed method study included two phases of data collection. Phase one included the use of an electronic questionnaire distributed to registered dental hygienists. In January, 2016, the questionnaire was sent electronically to 1,289 dental hygienists with a response rate of 22%. The survey asked participants for basic demographic information, and then asked them both selected response and open-ended questions specifically about what motivated them to go into dental hygiene and what experiences they have had in school and since graduating, and their recommendations regarding recruitment. Data from the survey responses were evaluated in an effort to establish potential questions for follow-up in-depth interviews. The second phase of the study included confidential, personal, in-depth interviews with 17 registered dental hygienists who identify as URM dental hygienists. The transcripts from the in-depth personal interviews were analyzed manually using a coding technique to identify common themes and subthemes that emerged from the transcribed responses. IRB approval was obtained from Youngstown State University.

Results: Responses from the dental hygiene questionnaire report that the most common reason for choosing the profession of dental hygiene was referral from a dental professional or prior dental assisting experience (52.03%). The most highly recommended recruitment efforts to expose URM students to the dental hygiene profession included; increasing the public's image about the profession (7.41%) and targeting high school students (18.52%). Analysis of the in-depth interviews with URM dental hygienists revealed that visiting high schools for career day, using social media to market to millennials, and utilizing alternative admission criteria were suggested as recruitment strategies to target URM students. Results include feedback about employment prospects and job experiences that provide insights to the success and challenges experienced by the URM dental hygienists.

Conclusions: Results indicate that referrals by individuals in the dental profession impacted many of the respondents' motivation to enter the dental hygiene field. Some respondents indicate that there have been challenges with securing employment in areas with low minority populations. Lastly, recommendations for recruitment included going to high schools and efforts towards changing the image of the profession.

Dental Hygienists' Perspectives on Four Periodontal Instrument Handle Designs

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Problem: Developing new instrument designs to address the ergonomics of instrumentation and to decrease repetitive strain injuries in the dental hygienist is an ongoing area of development. Changing the weight and diameter of instrument handles has been suggested to reduce risk for trauma in the practitioner but minimal research has been conducted to determine design preferences of practicing dental hygienists.

Objective: The purpose of this study was to assess dental hygienists opinions on the weight, diameter, balance and maneuverability of four different instrument handles.

Methodology: After IRB approval, a convenience sample of 27 practicing dental hygienists from Virginia participated in the study. Four typodonts were set up for each participant with a different instrument randomly assigned for use on each. Subjects scaled first molars coated with artificial calculus using a Columbia 13/14 curet with four commercially available handle designs that varied in weight and diameter: A) 16 grams and 12.7 mm diameter; B) 23 grams and 11.1 mm diameter; C) 21 grams and 7.9 mm diameter and D) 18 grams, and 6.35 mm diameter. Following scaling participants used a 6 item survey to rate their comfort level on a 5-point scale ranging from 1 (very comfortable) to 5 (uncomfortable) with regard to balance, weight, diameter, maneuverability and overall preference. A Friedman test determined significant differences between participants' perceptions. A Wilcoxan signed rank test followed if differences were found.

Results: Handle designs had significant effects on dental hygienists' instrument preferences while performing simulated scaling. Results revealed significant differences for participants' preferences concerning diameter ($x2(3)=50.584$, $p=0.000$), weight ($x2(3)=24.650$, $p=0.000$), balance ($x2(3)=69.504$, $p=0.000$) and maneuverability ($x2(3)=67.728$, $p=0.000$). When comparing comfort based on diameter grip, results reveal instrument D was least comfortable compared to A, B and C ($p=0.000$, $p=0.000$, $p=0.000$). Instrument A was most comfortable in weight when compared to all other instruments ($p=0.008$, $p=0.000$, $p=0.000$). In regards to balance significant differences were found between instrument A when compared to both C and

D (p=0.000, p=0.000), with instrument A having the highest mean score (x=4.7). Finally, instrument A was rated most comfortable for maneuverability (p=0.003, p=0.000, p=0.000). Sixty-three percent of participants preferred instrument A, 26% instrument B, 11% instrument C and none preferred D.

Conclusion: When performing simulated scaling, results indicate most participants preferred using a lighter weight, larger diameter instrument handle. Diameter affected preference more than weight. The smallest diameter handle was always ranked the lowest with regards to balance, weight, diameter and maneuverability although it was not the heaviest.

"An Interprofessional Collaboration to Implement and Evaluate an Adult Diabetes Screening Program in a Dental/Dental Hygiene School Clinic"

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Purpose: The purpose of this project was to collaborate with the School of Nursing and School of Dentistry to determine the feasibility of screening patients for diabetes/prediabetes during their hygiene appointments at the UM dental school clinic.

Significance: Diabetes is an epidemic in the United States and is associated with significant morbidity and mortality. Currently, about 18.8 million Americans have diabetes and of those about one third are undiagnosed. 86 million have prediabetes and 90% are unaware. The U.S. Preventative Task Force recommends screening adults who have risk factors for diabetes. Most adults with periodontal disease have at least one risk factor for diabetes. The literature revealed there is a bidirectional relationship between diabetes and periodontal disease. Of, people who are at risk for diabetes, 50% have seen a dentist in the last year. This makes the dental clinic an ideal site for diabetes screening. Dental visit screening enhances the role dental providers' play in the overall health of their patients. Specifically screening in a dental hygiene clinic and at a dental hygiene appointment appear to be a perfect fit between medicine and dental interventions. Interprofessional collaboration among dental hygiene, dental and nurse practitioner faculty toward integrating diabetes screening procedures during dental hygiene care, will be a seamless routinization toward care.

Key features: The University of Maryland IRB determined the project was exempted. The dental hygiene clinic was chosen for the screening program. An orientation session was initially provided to the faculty and students by the Dental School and Nursing School faculty and diabetes risk factors were reviewed. During the clinic session those patients with risk factors were offered screening testing with a glucometer. All patients with risk factors were offered written materials about diabetes prevention and the students provided lifestyle recommendations. From those patients who consented to the screening a fingerstick blood glucose sample was obtained. Patients with a fasting result > 100 mg/dL or random result > 140 mg/dL were referred to their primary care provider. If the patient did not have a primary care provider the patient was referred to the academic center's outpatient diabetes clinic.

Currently in Maryland, dental hygienists are NOT allowed to do this screening, thus a dentist within the Dental School faculty along with a Nurse Practitioner, tested the patients.

Evaluation Plan / Results: Descriptive statistics were utilized to evaluate the data. A total of 67 patients were seen, 4 were excluded for age; they were under 19 years old. The remaining 63 patients were screened for diabetes risk factors. They ranged in age from 21 to 89 the mean age was 55. Of these 63 patients, 49 (73.1%) had at least one risk factor for diabetes, and 14 (20.9%) did not have any identifiable risk factors. The remaining 45 people were offered a blood glucose evaluation for diabetes with glucometer. Over 50% of the patients (24/55%) agreed to the glucometer evaluation. Of the patients who were screened, 1 patient had an abnormal screen and was referred to the University outpatient diabetes clinic. The remaining 23 screened within normal limits.

Conclusion: The screening process flowed easily as part of the dental appointment as many components were already in place. Medical history review was already part of the existing dental hygiene appointment and the dental hygiene students routinely provide health promotion education, as part of the clinic visit. The diabetes screening was well received by faculty, students, and patients. More than half of the patients who with risk factors agreed to be screened. Of those who declined screening, most reported they had been screened elsewhere. However, the numbers were small, thus the next step is to expand the diabetes screening to all of the dental hygiene clinics, and to have the dental hygiene faculty maintain the glucometers and perform the glucometer reading. Ultimately, diabetes screening should be part of the assessment conducted by dental professionals during the medical history/dental assessment visit. The study showed that it was innovative, easily implemented and patients were very open to being tested.

Effect of Oral Environmental Conditions on Adhesion of Conventional Denture Adhesives

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Purpose: Current denture adhesives often dissolve in the mouth after eating and drinking. It is important for manufacturer to figure out the mechanism of adhesive failure.

Objective: Evaluating the effects of changes in oral environment conditions such as pH, temperature and salivation on the adhesion of denture adhesive product

Methods: This experimental study was evaluating the effect of different pHs (2,7,10), temperatures (0, 37, 60 °C) and moisture levels (hyposalivation, normal and hypersalivation) on adhesion strength. To determine the adhesion strength, tensile bond and lap shear tests were carried out according to International Standards Organization (ISO 10873) and American Society for Testing and Materials (ASTM F2255). To prepare the sample, 0.2 g of commercial denture adhesive soaked in artificial saliva which made based on Fusayama Meyer formula for 10 minutes. At least ten samples of each three conditions (pH, temperature and moisture level) were tested and the mean and standard deviations were calculated.

Results: The results indicated that the environmental conditions had a significant impact on the adhesion force of the material. In particular, the adhesion force showed a reverse relationship with temperature and, while salivation improved the adhesion force. The adhesion strength at 37 °C was approximately 3996 Pa compared to 4302 Pa at 0°C and 3177 Pa at 60 °C. The pH 10 showed significantly less adhesion in comparison to other pHs (p= 0.02 between pH7 and 10, p=0.0005 between pH 2,10). The tensile strength in acidic environment (6096 Pa) was almost twice of the value at pH 7 (3996 Pa). The hyposalivation group showed the least adhesion among all groups (2684 Pa). There was significant difference between hyposalivation, hypersalivation in comparison with the control group (p=0.001 and p=0.002 in order).

Conclusion: Among different oral conditions, hyposalivation had the greatest effect on adhesion. Thus, it is expected that the adhesion strength of denture adhesives to be lower in patients with hyposalivation and higher pHs. The denture adhesive showed the highest strength in acidic condition and lowest temperature.