CANADIAN JOURNAL OF DENTAL HYGIENE · JOURNAL CANADIEN DE L'HYGIÈNE DENTAIRE
THE OFFICIAL JOURNAL OF THE CANADIAN DENTAL HYGIENISTS ASSOCIATION

CJDH JCHD

JUNE 2016 · VOL. 50, NO 2

Acculturation and oral health behaviours of Japanese immigrants in Vancouver, Canada

Examining changes in income-related oral health inequality in Canada

The impact of occupation-related musculoskeletal disorders on dental hygienists

EDITORIALS

A journey into the future of dental hygiene and the journal in 2066

Graduate dental hygiene education

50
CJDH JCHD
1966 - 2016

Hu-Friedy's promise to help you perform at your best is at the core of everything we do, which is why we're proud to bring you the sharpest, longest lasting scaler on the market: EverEdge 2.0. **Engineered to be better than ever, so you can be, too.**

Learn why EverEdge 2.0 is the solution for you at Hu-Friedy.com/EE2

How the best perform Hu-Friedy®

Publisher
Canadian Dental Hygienists Association
1122 Wellington St W, Ottawa, ON K1Y 2Y7
Tel: 613-224-5515 or 1-800-267-5235
Fax: 613-224-7283; Email: journal@cdha.ca

Managing Editor
Megan Sproule-Jones, MA

Production
Mike Roy, Tim Logan

Advertising
Peter Greenhough, Keith Communications Inc.
1-800-661-5004; or
pgreenhough@keithhealthcare.com

Front cover: ©iStockphoto.com/tashechka, modified to represent the seasonal publication of the journal.

ISSN 1712-171X (Print)
ISSN 1712-1728 (Online)

Canada Post Publications Mail agreement #40063062. Return undeliverables to CDHA, 1122 Wellington St W, Ottawa, ON K1Y 2Y7

THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

CONTENTS

JUNE 2016 VOL. 50, NO. 2

EDITORIALS

ORIGINAL RESEARCH

LITERATURE REVIEW

BOOK REVIEW

INFORMATION

The *Canadian Journal of Dental Hygiene* is the official peer-reviewed publication of the Canadian Dental Hygienists Association (CDHA). Now published in February, June, and October, the journal invites submissions of original research, literature reviews, case studies, and short communications of scientific and professional interest to dental hygienists and other oral health professionals. Bilingual *Guidelines for Authors* are available at www.cdha.ca/cjdh.

CJDH is indexed in the following databases: CINAHL; EBSCOhost; ProQuest; Scopus; Thomson Gale

NEW!
BREAKTHROUGH DAILY 2-STEP SYSTEM

CREST® PRO-HEALTH™ IS POLYETHYLENE BEAD FREE!

STEP 1
for 1 minute

Stannous fluoride antibacterial toothpaste

STEP 2
for 1 minute

Hydrogen peroxide whitening gel

Crest® PRO-HEALTH™ [HD]™

A daily 2-step toothpaste and gel system that helps promote gum health† and noticeable whitening* benefits with regular brushing
AND an exhilarating clean that your patients will have to try to believe.

†Via Step 1 stannous fluoride antibacterial toothpaste.
*At 3 weeks of treatment.

A journey into the future of dental hygiene and the journal in 2066

Salme Lavigne, PhD, RDH

As we celebrate this golden anniversary of the *Canadian Journal of Dental Hygiene* (CJDH), I cannot help but wonder what the next 50 years will look like. When I reflect upon the vast amount of growth and change that both the journal and the profession have experienced over the past 50 years, it's pretty mind-boggling! We have evolved from being a fledgling new profession with only 5 dental hygiene schools in 1966 to now having 36 accredited programs across Canada. The early schools were all located in universities and were 2-year diploma programs. Now the majority of Canadian dental hygiene programs are 3 years in length, with one being 4 years and awarding a bachelor's degree. There are also several degree completion programs available as well as one master's degree program.

Salme Lavigne

The Canadian Dental Hygienists Association (CDHA) has evolved from its humble beginnings in the basement of the founding executive director's home, who was the sole employee, to owning our own building that houses 18 employees! We are now a well-recognized health profession in Canada, and we make our voices heard through concerted government advocacy initiatives. We have achieved self-regulation in all but one of the 10 provinces, although not the territories. Self-regulation was not even a consideration 50 years ago when we were regulated by dentistry. Similarly, most provinces (and territories) are now able to self-initiate client care and, in several provinces, dental hygienists practise independently. Although there is great diversity within our scopes of practice across Canada, there has been considerable growth since our early beginnings. The addition of a "Dental Hygiene Process of Care" has given us a more theoretical approach to practice and has changed the way we deliver care to our clients. We have also seen the inclusion of procedures such as local anesthesia and restorative techniques in numerous provinces, as well as the addition of procedures such as nitrous oxide-oxygen conscious sedation and prescription of medications in some jurisdictions.

The journal had its beginnings in 1966 as a magazine that published CDHA news and events and some articles of interest to practitioners. However, over the past 50 years it has evolved into the formidable peer-reviewed open access journal that we have today with an international editorial board and readership! Research and statistics have been incorporated into current dental hygiene curricula, enabling new dental hygienists to have a better understanding of and ability to interpret research articles that now appear in our journal.

We truly should be proud of our accomplishments as a profession and with the journal. So, what do the next 50 years hold? What do we envision for the profession and for the journal? Perhaps most of you haven't given it much thought. I will share my vision with you, as all progress first starts with a vision. You can form your own opinions of my vision and add some of your own thoughts and dreams of what you think the future holds for us.

My vision has many components. First of all, I envision a future where dental hygienists will all possess a minimum of a bachelor's or possibly a master's degree in dental hygiene as an entry-to-practice credential. This may seem a bit lofty, yet all of the allied health professions that began, like dental hygiene, at the diploma level 50 years ago (nursing, physiotherapy, occupational therapy, and speech language pathology) now require a minimum of either a bachelor's degree or a master's degree, with some professions requiring a doctoral degree (pharmacy), for their entry-to-practice credential. Dental hygienists who studied in the early university programs all studied alongside and with these other health professionals. Although our profession has experienced remarkable growth, we have not seen our educational credentials evolve with that growth. The world has changed tremendously over the past 50 years: research has multiplied exponentially, particularly with evidence about oral-systemic linkages, new products, and procedures; new scopes of practice have been added to already demanding dental hygiene curricula; and, of course, the oral health care needs of underserved populations in Canada remain ever-present. Higher education provides us with the skills required to

Correspondence to: Dr. Salme Lavigne, CJDH Scientific Editor; scientificeditor@cdha.ca

respond effectively to these challenges.

The second part of my vision is that dental hygienists in Canada 50 years from now will not only be primary health care providers, but they will also be well-respected members of integrated interdisciplinary health care teams. The introduction of interprofessional education initiatives by the Government of Canada over the past 10 years, touching most health programs across the country, has changed the way all health professionals are educated. The principal premise of interprofessional education is that students from more than one (and preferably numerous) health professions are taught together to learn "with," "from," and "about" each other in order to deliver better patient care.[1] This initiative has been introduced to change the way that health care is delivered, not only in Canada but globally, because governments, the World Health Organization, and organized health professions all recognize that the way health services are currently delivered is not working.[1] We live in a society, in Canada, where we are privileged to have publicly funded health care coverage, yet dental care follows a "fee-for-service model." For those who are able to pay for their oral care, this model works well. But of the 32% of the Canadian population who do not have dental insurance,[2] the majority cannot afford to pay for their oral health needs. This underserved population is comprised of the working poor, the institutionalized, older adults living in the community, those living in nursing homes and chronic care facilities, First Nations and Inuit populations, immigrants, refugees, the homeless, and countless others.

The idea of more interprofessional models of health care delivery has been proposed recently by the Canadian Academy of Health Sciences (CAHS). Such a model is described as an integrated health care system that: 1) is focused on the person (and family or friend/caregiver); 2) provides comprehensive services using interprofessional teams; 3) links with other sectors in health and social care; and 4) is accountable for outcomes.[3,4] The CAHS report further suggests that this integrated model would fulfill their vision for health care reform in Canada.[4] Interestingly, a similar integrated model of care has been implemented in the United States based on President Barack Obama's 2010 *Patient Protection and Affordable Care Act*, which encouraged the creation of community health centres that were more interdisciplinary and integrated in nature.[5] These proposed centres were to include health professionals of all types (including oral care professionals) working together to provide a true "Medical Home" for all Americans.[5]

Thus, my vision for the future includes dental hygienists who will serve as coordinators or patient navigators of oral health services for marginalized and underserved populations. They will triage oral care for the marginalized and ensure that they receive oral health services as well as appropriate health and social services throughout the health care system. As preventive health specialists, dental hygienists will be an integral part of Canada's health care system.

The third part of my vision has to do with the journal. With the increase in educational credentials and expansion of our practice roles, I envision a much larger cohort of dental hygiene researchers all contributing significantly to the dental hygiene body of knowledge. CJDH will become a highly sought-after journal, both nationally and internationally, for the publication of original research and systematic reviews to help guide oral health care professionals in their evidence-informed multifaceted practice decisions. In its pursuit of excellence, the journal will publish numerous robust issues annually and will be indexed in Medline/PubMed, greatly enhancing its worldwide access and visibility.

Here's to the continued growth of dental hygiene as a profession and to the growth of CJDH!

"If you can dream it, you can do it."
— Walt Disney

REFERENCES

1. Health Professions Network Nursing and Midwifery Office (WHO). *Framework for action on interprofessional education and collaborative practice.* Geneva: WHO; 2010. Available from http://whqlibdoc.who.int/hq/2010/WHO_HRH_HPN_10.3_eng.pdf?ua=1
2. Health Canada. *Summary report on the findings of the oral health component of the Canadian Health Measures Survey, 2007–2009.* Ottawa: Health Canada; 2010 [cited2010 Jun 1]. Available from www.fptdwg.ca/assets/PDF/CHMS/CHMS-E-Summ.pdf
3. Nelson S, Turnbull J, Bainbridge L, Caulfield T, Hudon G, Kendel D, et al. *Optimizing scopes of practice: New models of care for a new health care system.* Ottawa: Canadian Academy of Health Sciences; 2014. Available from http://cahs-acss.ca/wp-content/uploads/2015/07/Optimizing-Scopes-of-Practice_REPORT-English.pdf
4. Nasmith L, Ballem P, Baxter R, Bergman H, Colin-Thomé D, Herbert C, et al. *Transforming care for Canadians with chronic health conditions: Put people first, expect the best, manage for results.* Ottawa: Canadian Academy of Health Sciences; 2010. Available from www.cahs-acss.ca/wp-content/uploads/2011/09/cdm-final-English.pdf
5. Sparer M. US health care reform and the future of dentistry. *Am J Public Health.* 2011;101(10):1841–44.

IN THIS ISSUE

We are delighted to feature two original research articles in this issue. The first, by **Keiko Ogami, Tara Johnson**, and **Denise Bowen**, examines relationships between acculturation patterns and oral health behaviours and attitudes among Japanese immigrants in Greater Vancouver, British Columbia, concluding that targeted oral health education initiatives should be implemented for this population (p. 55). The second, by **Julie Farmer, Logan McLeod, Arjumand Siddiqi, Vahid Ravaghi**, and **Carlos Quiñonez**, studies changes in income-related oral health inequality in Canada, demonstrating that income gradients in oral health have persisted over time despite overall reductions in caries rates (p. 65). We are also pleased to present a narrative review, by **Courtenay Johnson** and **Zul Kanji**, of research on work-related musculoskeletal disorders among dental hygienists, which includes recommendations for future studies on this subject (p. 72). In addition, **Ava Chow** in her guest editorial discusses the importance of graduate dental hygiene education, not only for the growth of the profession, but also for the provision of leading-edge, evidence-informed clinical care (p. 51). **Karen Gallagher** rounds out this issue with her review of *At the forefront: Illustrated topics in dental research and clinical practice* (p. 83).

As always, we invite new and experienced authors alike to consider the journal for publication of their work. For more information on submitting manuscripts to the journal, please consult our *Guidelines for authors* on page 89 or contact the editorial office at journal@cdha.ca

#500 1055 14th Street West,
North Vancouver, BC, V7P 3P2

OCEAN PACIFIC
medical gloves

toll free: 1.888.293.2287
www.ocean-pacific.ca

MORE CHOICES, MORE SAVINGS!

Vinyl Gloves

Average Finger
Average Palm

Fusion
powder free, vinyl, eco-friendly, cream colour, phthalate free, 100/box

Opex
powder free, vinyl, eco-friendly, natural colour, phthalate free, 100/box

Latex Gloves

Average Finger
Average Palm

Comfort Flex
powder free, latex, natural colour, palm & fingertip texture, 100/box

Extreme
powder free, latex, natural colour, low protein, fully textured, 100/box

Comfort Flex
lightly powdered, latex, natural colour, smooth surface, 100/box

All Ocean Pacific gloves provide excellent protection from bloodborne pathogens including HIV and Hepatitis.

Nitrile Gloves

Average Finger
Average Palm

Ninja
powder free, nitrile, black colour, extra thick, fully textured, 200/box

Harmony
powder free, nitrile, teal green colour, fingertip texture, 200/box

Intuition
powder free, nitrile, lilac blue colour, fingertip texture, 200/box

Ultra Touch
powder free, nitrile, cornflower blue colour, fingertip texture, 200/box

Eclipse
powder free, nitrile, midnight blue colour, fingertip texture, 200/box

Short Finger
Wide Palm

Lab Master
powder free, nitrile, low dermatitis, indigo blue colour, fingertip texture, 200/box

Aqua Blue
powder free, nitrile, low dermatitis, aqua blue colour, fingertip texture, 200/box

Dynamic
powder free, nitrile, white colour, fingertip texture, 200/box

Blue Lite
powder free, nitrile, cornflower blue colour, fingertip texture, 200/box

Long Finger
Narrow Palm

Flamingo
powder free, nitrile, rose pink colour, extended cuff, fingertip texture, 200/box

Titanium
powder free, nitrile, light silver colour, extended cuff, fingertip texture, 200/box

USE PROMO CODE: OP062016

Contact your distributor for details and pricing.

When placing your order, quote the above promo code to receive your savings!

**Not to be combined with any other offer. Offers expire June 30th, 2016.*

Graduate dental hygiene education

Ava K Chow, PhD, RDH

Dental hygiene, as a profession, is evolving rapidly throughout Canada. Not only has the scope of practice of dental hygienists changed dramatically since the establishment of the first dental hygiene school in North America in 1913, but the population that we now serve has vastly different oral health needs and is increasingly complex. Consequently, it is essential that dental hygiene education continue to evolve to train professionals who are able to meet the changing needs of the population and profession.

Ava K Chow

A comparison of previous and current Canadian Dental Hygienists Association (CDHA) Job Market and Employment Surveys demonstrates that, though there are an increasing number of members who elect to complete their baccalaureate degrees in dental hygiene, an even larger number have baccalaureates in other disciplines.[1] Similarly, the vast majority of members with graduate degrees have obtained those degrees in disciplines outside of dental hygiene. This is likely due, at least in part, to the lack of dental hygiene-specific graduate programs in Canada. (The University of Alberta has only recently implemented the first master's degree program in dental hygiene in Canada.) One might even ask why it is so important to have a degree specifically in dental hygiene? Anecdotal comments from dental hygienists have frequently defended degrees in other disciplines as "rounding out" the dental hygienists' knowledge.

However, as the profession of dental hygiene grows, it is necessary to train members in research, education, and advocacy in order to further develop dental hygiene-specific knowledge, skills, and capabilities. Though the dental hygiene profession has gleaned a great deal of invaluable research and information from other disciplines, dental hygiene is now reaching a critical mass where it is able to generate and contribute to its own body of knowledge. Thesis- and research-based graduate dental hygiene education not only contributes to the dental hygiene-specific knowledge base, but it also fosters independent thought, interprofessional collaboration, critical thinking, and ultimately serves to advance the profession as a whole.

These skills that are enhanced during graduate education can also be transferred into clinical practice. Critical thinking skills are necessary to synthesize the large amount of information that is presented in a complex case in order to formulate the most effective treatment plan. In fact, research has demonstrated that critical thinking skills of dental hygiene students are more predictive of their initial clinical performance than other traditional criteria such as GPA, student age, and postsecondary experience.[2] Additionally, as new research emerges, practitioners are required to continually evaluate the evidence and make educated decisions as to whether and how to incorporate this new information into practice. Graduate studies are an ideal opportunity for dental hygienists to hone these critical thinking skills.

Graduate dental hygiene education could also foster the interprofessional collaboration that is increasingly necessary in addressing the oral health needs of a complex population. With the growing number of studies that demonstrate an oral-systemic health link, both oral health and medical professionals are appreciating that clients should be treated in an interdisciplinary, collaborative manner. Though dental hygienists consider these interdisciplinary interactions to be valuable, they indicate that the type and quality of their current interactions with other professions are limited.[3] It is suggested that dental hygiene graduate education will allow dental hygienists to more fully appreciate their increasingly broad scope of practice[4] and may further cultivate multidisciplinary interactions by putting dental hygienists on equal footing with their counterparts from other health professions who have graduate education as an entry-to-practice requirement, such as physiotherapists and speech language pathologists.[5]

The credibility that is afforded by recognized graduate degrees would also contribute to the profession's ability to effectively advocate for our clients and lobby for change at the policy level. A doctoral degree is the pinnacle of education in any discipline, and the research that is done

Correspondence to: Dr. Ava K Chow, Assistant Professor, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB; akchow@ualberta.ca

by students during their graduate studies will contribute to the development of a scholarly identity for the profession.[6] The opportunity to demonstrate that the dental hygiene profession not only has a body of knowledge that is continually expanding, but that this knowledge is generated within the profession itself by highly skilled and knowledgeable clinicians and researchers will add to the authority of the profession's voice.

Graduate dental hygiene degrees could also open avenues for personal and professional growth. Graduate degrees can dramatically increase the employability of members by providing opportunities in education, community health, research, and leadership. Many dental hygiene schools in Canada require their faculty to have baccalaureate degrees, with master's or doctoral degrees preferred, in recognition of the fact that graduate training provides insight and skills over and above baccalaureate work. Graduate studies also foster the growth of skills that are transferrable to multiple aspects of personal and professional life. The nature of graduate studies allows for the development of interpersonal, written and oral communication, and analytical thinking skills, while at the same time providing opportunities to enhance organizational and time management skills, and, for senior graduate students, a chance to supervise, mentor, and lead more junior peers. All of these are invaluable, highly sought after transferrable skillsets that are gradually acquired during the graduate experience.

In summary, the current health care system in Canada and throughout the world is evolving. The focus is shifting to one of collaborative interdisciplinary teams with the goal of providing the best care possible for all individuals. Dental hygiene's specialization, since its inception, has been one of disease prevention and health promotion that includes the social determinants of health. We are a "perfect fit" in this emerging system particularly since we have recently assumed a more independent primary health care provider role in most Canadian provinces. That, along with the rapidly increasing evidence for oral-systemic connections, provides significant justification for our profession to assume more advanced roles. Graduate education now, more than ever before, will become critical to the growth and sustainability of the profession of dental hygiene and will enable us to assume our true role alongside other health professions as an integral part of the health care delivery system.

REFERENCES

1. Canadian Dental Hygienists Association. *Job market and employment survey: Report of findings.* Ottawa: CDHA; 2013. Available from: http://www.cdha.ca/cdha/Download?ProductID=__LABOR_SURVEY&tFileName=Labour_Survey_Full_Report.pdf

2. Williams KB, Glasnapp DR, Tilliss TS, Osborn J, Wilkins K, Mitchell S, Kershbaum W, Schmidt C. Predictive validity of critical thinking skills for initial clinical dental hygiene performance. *J Dent Educ.* 2003;67(11):1180–92.

3. Swanson Jaecks KM. Current perceptions of the role of dental hygienists in interdisciplinary collaboration. *J Dent Hyg.* 2009;83(2):84–91.

4. Vanderbilt AA, Isringhausen KT, Bonwell PB. Interprofessional education: The inclusion of dental hygiene in health care within the United States—a call to action. *Adv Med Educ Pract.* 2013;4:227–29.

5. Boyd LD, Bailey A. Dental hygienists' perceptions of barriers to graduate education. *J Dent Educ.* 2011;75(8):1030–37.

6. Walsh MM, Ortega E. Developing a scholarly identity and building a community of scholars. *J Dent Hyg.* 2013;87 Suppl 1:23–28.

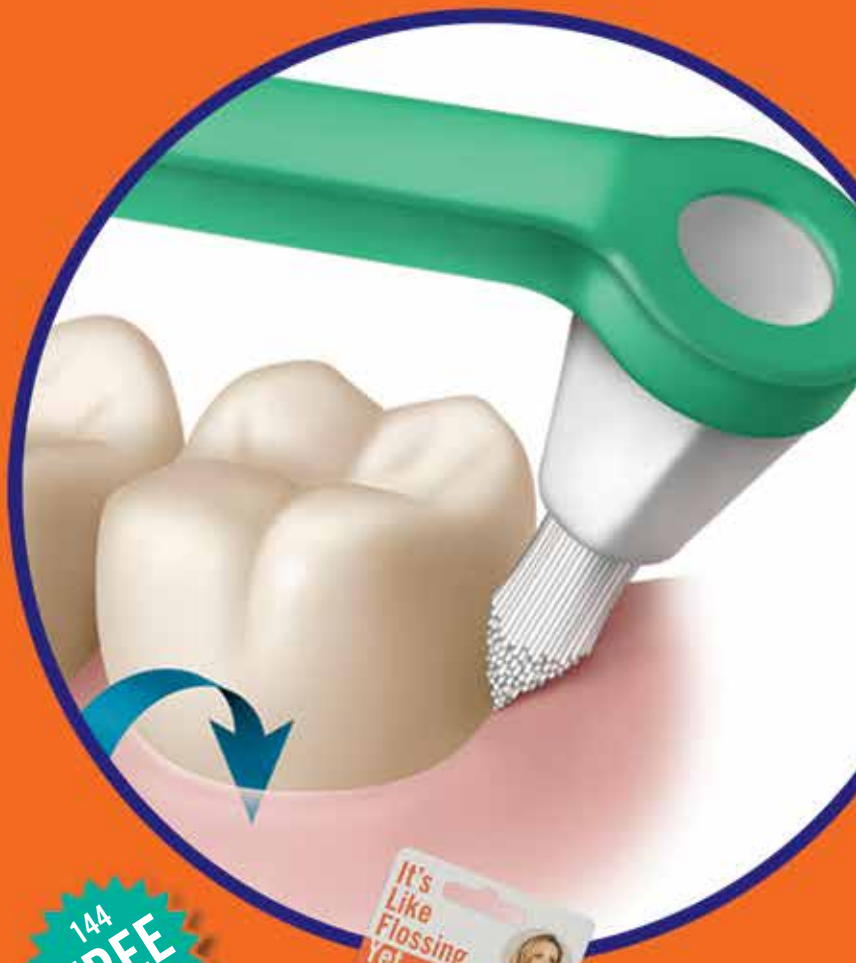
It's Like Flossing, Yet Easier!

CELEBRATING 30 A CANADIAN PRODUCT

Sulcabrush®

For Healthy Gums!

No strings attached!



Anniversary Special

Purchase 144 ***Sulcabrush®***
@ $1.25 ea. and receive
144 **FREE** pkgs. of tips

Offer expires December 31, 2016

DON'T DELAY
CALL TODAY!

1-800-**387-8777**

Proudly
Made in Canada

We have an idea that doesn't involve blue paper.

Introducing SALUS™, the world's first paperless, rack and sleeve, hygiene sterility maintenance container.

Consider the time, cost and environmental pressure of using hundreds of sheets of blue paper. We came up with something better. The SALUS Container enables you to effortlessly reprocess multiple instruments at a time.

It's the faster, safer, cost-effective way to optimize your practice.

Learn more at scican.com/salus

SciCan
A Sanavis Group Company

Your Infection Control Specialist™

scican.com

SciCan @SciCan SciCanTV

Acculturation and oral health behaviours of Japanese immigrants in Vancouver, British Columbia, Canada

Keiko Ogami[*], MSDH, RDH; **Tara Johnson**[§], PhD, RDH; **Denise Bowen**[‡], MS, RDH

ABSTRACT

Background: The purpose of this study was to examine relationships between acculturation patterns and oral health behaviours and attitudes among Japanese immigrants in Greater Vancouver, British Columbia, Canada. **Methods:** This cross-sectional study used 3 questionnaires: a self-designed demographic/socioeconomic questionnaire, the East Asian Acculturation Measure (EAAM) to identify acculturation patterns of East Asian immigrants after migration to North America, and a modification of the Hiroshima University Dental Behavioural Inventory (HU-DBI) to evaluate oral health behaviours and attitudes. The convenience sample (N = 48) was recruited by networking. Data were analysed using descriptive statistics, Spearman (r_s) and Pearson (r) correlations, independent samples t-test, and multiple linear regression analysis. **Results:** Mean HU-DBI scores were 3.16 of 12 total. Mean EAAM scores were as follows: assimilation, 2.86; separation, 3.71; integration, 4.41; and marginalization, 3.08 of 7.0 total. Pearson correlation analysis indicated an inverse association between age and assimilation (r = –0.392, p = 0.012). Income was significantly associated with oral health behaviours and attitudes (r_s = 0.287). Marginalization (p = 0.022), detachment from both cultures, was the only significant predictor of HU-DBI scores; the higher the marginalization, the lower the HU-DBI. Separation, the reconfirmation of traditional culture, was suggestive of a prediction (p = 0.051). **Conclusion:** Improvement in oral health behaviours and attitudes in Japanese immigrants is needed. Because a relationship exists between acculturation and oral behaviours/attitudes, oral health education in dental hygiene practice and public health programs should target Japanese immigrants, with special consideration for less acculturated individuals and those in lower socioeconomic strata. Further study of relationships between acculturation and oral health behaviours is indicated.

RÉSUMÉ

Contexte : La présente étude a été effectuée en vue d'examiner le lien entre les tendances d'acculturation et les comportements et les attitudes en matière de santé buccodentaire des immigrants japonais dans le Grand Vancouver en Colombie-Britannique (Canada). **Méthode :** Cette étude transversale a utilisé 3 questionnaires : un questionnaire démographique et socioéconomique maison, le *East Asian Acculturation Measure* (EAAM) pour cerner les tendances d'acculturation des immigrants d'Asie orientale à la suite de leur migration en Amérique du Nord, et une version modifiée du *Hiroshima University Dental Behavioural Inventory* (HU-DBI) pour évaluer les comportements et les attitudes en matière de santé buccodentaire. L'échantillon de commodité (N = 48) a été constitué au moyen de réseautage. Les données ont été analysées à l'aide de statistiques descriptives, de coefficients de corrélation de Spearman (r_s) et de Pearson (r), de test t d'échantillons indépendants et de multiples analyses de régressions linéaires. **Résultats :** Les scores moyens du HU-DBI étaient 3,16 sur 12 au total. Les résultats moyens du EAAM étaient comme suit : assimilation, 2,86; séparation, 3,71; intégration, 4,41; et marginalisation, 3,08 sur 7 au total. L'analyse du coefficient de corrélation de Pearson a démontré une association inverse entre l'âge et l'assimilation (r = –0,392, p = 0,012). Le revenu était considérablement associé aux comportements et aux attitudes en matière de santé buccodentaire (r_s = 0,287). La marginalisation (p = 0,022), le détachement par rapport aux deux cultures, était la seule variable explicative des résultats du HU-DBI; plus la marginalisation était élevée, plus les données du HU-DBI étaient faibles. La séparation, la reconfirmation de la culture traditionnelle, était évocateur d'une prédiction (p = 0,051). **Conclusion :** Il semble qu'une amélioration du comportement des immigrants japonais en matière de santé buccodentaire et de leurs attitudes envers celle-ci est nécessaire. En raison de la relation qui existe entre l'acculturation et les comportements et les attitudes envers la santé buccodentaire, l'éducation dans les cabinets d'hygiène dentaire et au sein des programmes de santé publique en matière de santé buccodentaire devrait cibler les immigrants japonais tout en prêtant une attention particulière aux personnes moins acculturées et celles des classes les plus défavorisées sur le plan socioéconomique. Une étude plus approfondie du lien entre l'acculturation et les comportements en matière de santé buccodentaire est recommandée.

Key words: acculturation, health behaviour, oral health

INTRODUCTION

Acculturation is the phenomenon that occurs when migrants change their cultural pattern over time in their host countries as a result of exposure to a new culture.[1] It is one of the major factors influencing the general and oral health of immigrant populations, particularly for those individuals who relocate from less developed to more

[*]Department of Dental Hygiene, Idaho State University, Pocatello, ID, USA
[§]Associate Professor, Department of Dental Hygiene, Idaho State University, Pocatello, ID, USA
[‡]Professor Emeritus, Department of Dental Hygiene, Idaho State University, Pocatello, ID, USA

Correspondence to: Denise M Bowen; bowedeni@gmail.com
Submitted 22 February 2016; revised 10 May 2016; accepted 12 May 2016

developed countries.[2,3] For decades, research has identified a relationship between acculturation and general health.[4-6] Evidence also supports a relationship between acculturation and oral diseases (dental caries and periodontal disease). Limited information is available regarding acculturation and oral health behaviours.[3]

When people emigrate from their native countries, they are exposed to new and sometimes unfamiliar cultures. Berry observed that people experience 4 possible acculturation outcomes after they reside in a new country for a period of time: assimilation (adoption of the dominant culture); separation (reconfirmation of the traditional culture); integration (combination of the two cultures); or marginalization (detachment from both cultures).[7] Based on these constructs, Barry developed the East Asian Acculturation Measure (EAAM) as a useful tool for researchers and clinicians to investigate the acculturation patterns of East Asian immigrants.[8] The different dimensions of acculturation are important indicators in assessing health-related knowledge, attitudes, beliefs, and practices; utilization of the health care system; and clinical outcomes. Mariño et al. suggested that cultural factors might be more important than immigrants' socioeconomic status (educational level, employment status or language) when developing public health programs or treatment approaches.[9]

Literature review

Several studies have assessed the relationship between demographic/socioeconomic characteristics, especially gender and age, and oral health status and/or behaviours, attitudes, and beliefs in Japan. Differences in oral health status, oral health behaviours, and related factors have been identified between sexes among Japanese adults.[10-12] In general, women have been found to have better oral health, oral health behaviours, and more knowledge about dental health than men.[10,11] Factors associated with oral health status, such as frequency of toothbrushing, interdental cleaning or tobacco use, have been shown to differ in men and women.[11,12] However, Kawamura and Iwamoto discovered that gender was not a major factor, whereas age significantly affected perceptions about oral health and disease in employed adults in Japan.[13] Hsu et al. found that age and education level were associated with the number of remaining teeth and oral health status.[14] Likewise, Ueno et al. found an association between various measures of oral health and the education level of Japanese adults.[15]

Studies of factors affecting the oral health of immigrants to North America have identified an association between acculturation attributes and oral disease. Cruz et al. studied immigrants in New York City and identified immigrants' birth country, length of stay in the host country, and age at immigration as factors that played important roles in oral disease prevalence, independently of most known risk factors for oral disease.[16] Calvasina et al. concluded that immigrants who have no dental insurance and low annual household incomes were more likely to report unmet dental care needs than those with dental insurance and higher incomes.[17]

Oral health behaviours, attitudes, and beliefs are known variables related to oral health status. Studies of individuals residing in East Asia indicate less than ideal oral health behaviours and habits in these countries of origin. Frequent toothbrushing, interproximal cleaning, regular dental check-ups, and acceptance of professional advice were associated with good oral health in a population of dental school clinic patients in Japan, although plaque control was generally inadequate.[18] Oral health behaviours and habits of older Taiwanese individuals were found to be associated with number of remaining teeth. Individuals who were older, had less education, were infrequent floss users, were smokers, had poor self-perceived dental health, and were former betel-nut chewers had fewer remaining teeth.[14] Research findings also have identified relationships between acculturation or cultural beliefs and behaviours, attitudes, and health beliefs in East Asian immigrants residing in the Western world. Mariño et al. found that acculturation was related to occupation, age, level of education, and immigration variables in the Vietnamese population living in Melbourne, Australia.[9] Acculturation was also related to 3 oral health variables: oral health knowledge, number of dental visits within the previous 12 months, and dental caries history.

Immigrants have demonstrated poorer oral health than native-born populations, and lack of dental insurance, low income, and ethnicity have been found to predict unmet dental care needs in immigrants to Canada.[17] Gao and McGrath undertook a literature review to determine the oral health implications of acculturation.[3] Fifteen studies included in their review found better oral health among acculturated immigrants; however, this association could not be attributed to more frequent dental visits. Therefore, these authors recommended studies of oral health behaviours and diseases using refined acculturation scales to improve the understanding of the course of immigrants' oral health along the acculturation continuum. A study of perceptions of oral diseases in Chinese populations in Montreal, Canada, revealed that most participants possessed scientific knowledge about dental caries, such as the basic etiology and progression of carious lesions.[19] The participants relied on both Western and traditional beliefs and behaviours to prevent and treat gingival swelling, but held traditional beliefs regarding causes and prevention of gingival bleeding. Results of this study implied that cultural beliefs influenced oral health behaviours. Similarly, a metasynthesis of the literature on elderly Chinese immigrants in Western countries found not only that religion and culture played an important role in the identification and treatment of health problems, but also that Chinese health beliefs were stronger in older and

Figure 1. Modified version of Hiroshima University-Dental Behavioral Inventory (HU-DBI)

	Please answer each question based on your level of agreement or disagreement with each item. Items	1 Strongly disagree	2 Disagree	3 No opinion or uncertain	4 Agree	5 Strongly agree
1.	I don't worry much about visiting the dentist.					
2.	My gums tend to bleed when I brush my teeth.[a]					
3.	I worry about the color of my teeth.					
4.	I have noticed some white sticky deposits on my teeth.[a]					
5.	I use a child-sized toothbrush.					
6.	I think that I cannot help having false teeth when I am old.[a]					
7.	I am bothered by the color of my gums.					
8.	I think my teeth are getting worse despite my daily brushing.[a]					
9.	I brush each of my teeth carefully.[a]					
10.	I have never been taught professionally how to brush.[a]					
11.	I think I can clean my teeth well without using toothpaste.[a]					
12.	I often check my teeth in a mirror after brushing.[a]					
13.	I worry about having bad breath.					
14.	It is impossible to prevent gum disease with tooth brushing alone.[a]					
15.	I put off going to the dentist until I have toothache.[a]					
16.	I have used a dye to see how clean my teeth are.[a]					
17.	I use a toothbrush with hard bristles.					
18.	I don't feel I've brushed well unless I brush with strong strokes.					
19.	I feel I sometimes take too much time to brush my teeth.[a]					
20.	I have had my dentist tell me that I brush very well.					

[a]Questions for scoring

less educated Chinese immigrants.[20] This metasynthesis also revealed that traditional cultural beliefs influence oral health behaviours and attitudes. In summary, health beliefs and oral health behaviours and attitudes in East Asian populations and immigrants are influenced by both demographic/socioeconomic factors (especially age, education, and sex) and cultural background and beliefs. These health beliefs and oral health behaviours and attitudes in turn affect oral health status.

To date, there have been few studies published on acculturation and its impact on oral health behaviours and attitudes, especially regarding Japanese immigrants residing in Canada. The Japanese community in Canada is growing faster than the overall population. Furthermore, the largest share of the Japanese population in Canada is located in British Columbia (BC); over half of all Japanese Canadians live in the Greater Vancouver metropolitan area.[21] An investigation of the relationship between different acculturation patterns and oral health behaviours and attitudes is needed to identify potential factors that may ultimately clarify the complex relationship between acculturation and oral health. The purpose of this study was to examine relationships between acculturation and oral health behaviours and attitudes among Japanese immigrant populations in Greater Vancouver, BC, Canada.

Significance of the work

Oral health disparities exist between immigrant and non-immigrant populations in Canada.[22] Consequently, this study investigated whether demographic and socioeconomic variables and different patterns of acculturation, including maintenance of traditional cultural beliefs and adoption of Canadian culture, were associated with oral health behaviours and attitudes. In so doing, it addressed one of the research pillars of the Canadian Institutes of Health Research (CIHR), namely "social, cultural, environmental and population health." The *Research Agenda* of the Canadian Dental Hygienists Association identified several areas of study within the context of this CIHR pillar: social and economic impact of oral health and disease on populations, barriers and opportunities for oral care for all populations, and cultural and linguistic relevance of dental hygiene services.[23]

Through dissemination of the findings of this study, awareness of patterns of acculturation and oral hygiene behaviours and attitudes of immigrants may increase among dental hygienists. Ultimately, dental hygienists may utilize the findings from this study to inform their client care and education.

The study was designed to answer the following research question:

- Is acculturation in the Japanese adult immigrant population in Greater Vancouver, Canada, related to self-reported oral hygiene behaviours and attitudes?

The research hypothesis tested was as follows:

- There will be a relationship between acculturation as measured by the EAAM and oral hygiene behaviours and attitudes as measured by a modified version of the Hiroshima University-Dental Behavioural Inventory (HU-DBI) in Canadian immigrants of Japanese origin.

METHODS

An application for expedited review of this study was submitted to the Idaho State University (ISU) Institutional Review Board, the Human Subjects Committee (HSC), and approval was obtained before subject recruitment and enrollment (IRB-FY2015-84). This cross-sectional, quantitative study used 3 short questionnaires: a self-designed demographic and socioeconomic questionnaire, the EAAM, and the HU-DBI. The EAAM contains 29 questions related to the 4 dimensions of acculturation as described by Berry: assimilation (8 items), separation (7 items), integration (5 items), and marginalization (9 items) with a 7-point Likert scale (strongly disagree, disagree, disagree somewhat, neutral, agree somewhat, agree, strongly agree) to score for each item. The 4 dimensions measure different aspects of acculturation. There is no total EAAM score, as immigrants in multicultural societies, such as Canada and the US, tend to use one of the 4 strategies.[7,8] The EAAM instrument was shown to be valid and reliable at the time of its development.[8]

The HU-DBI was selected for this study because it was designed in Japan using the Japanese language and later validated in English, implying some degree of usability for English-speaking Japanese immigrants, the sample in this study. Although the original HU-DBI, developed and validated by Kawamura, included 20 items with dichotomous response options of agree or disagree, Kawamura's original HU-DBI scale includes only 12 of those items for scoring (Figure 1).[24] Kawamura chose these 12 items based on their statistically significant correlation with oral hygiene-related conditions (i.e., plaque, calculus, gingival condition, probing depth) as measured by the Oral Rating Index. When calculating HU-DBI scores, one point was given for each agree response to items 4, 9, 11, 12, 16, and 19 and one point was scored for disagree responses to items 2, 6, 8, 10, 14, and 15.[25,26] The only modification made was to expand the response options to a 5-point Likert scale (strongly disagree, disagree, no opinion, agree or strongly agree) to allow for more varied responses and provide continuous data for statistical analysis. A test-retest was administered to Japanese immigrants (N = 5) following this scale revision, with 3 weeks between the first and second tests. The mean correlation coefficient for proportion of exact agreement was 0.868 with 0.696 minimum and 1.0 maximum; the proportion of agreement + or −1 was 0.94 with a minimum of 0.85 and maximum of 1.0, indicating that the modified instrument was stable and reliable.

A convenience sample of 48 first-generation Japanese immigrant volunteers in Vancouver, Canada, was used based on feasibility and cost. Participants were recruited through networking. Inclusion criteria were as follows: first-generation Japanese immigrants residing in Greater Vancouver; at least 18 years of age; self-reported average or fluent English; and English not spoken as their native language. Individuals with experience in the dental profession or industry were excluded from the study due to the potential impact on oral health attitudes and behaviours. To control for confounding variables, volunteers who only spoke or read Japanese were also excluded, and the questionnaire was administered in English. The surveys were delivered personally, through the postal service or as an e-mail attachment; to maintain confidentiality, only hard copies of respondents' surveys enclosed in a sealed envelope were accepted.

Data were analysed using descriptive statistics, Spearman rank correlation coefficient (r_s) for ordinal data, and Pearson correlation coefficient (r) for continuous data to assess the relationships between demographic/socioeconomic variables, acculturation, and oral health behaviours and attitudes. The independent samples t-test was used to analyse differences in EAAM and HU-DBI scores based on gender, language spoken at home, and place of education. Multiple linear regression was used to observe the effects of 4 potential predictor variables (the acculturation dimensions measured by the EAAM) on the dependent variable, the HU-DBI. All analyses were performed using IBM SPSS Version 23. The alpha level set for statistical significance was ≤0.05.

RESULTS

Forty-eight eligible participants responded to the surveys. The majority of the participants were female (72.9%). The average age of the participants was 39 years. Two-thirds of the participants reported speaking Japanese at home, and 58.3% of the participants spoke only one language at home. Most of the participants (91.7%) identified their English skills as fair to good. Table 1 summarizes all demographic and socioeconomic data.

The EAAM dimension scores, based on a 7-point Likert scale and a maximum total score of 7.0 points, are presented in Table 2. Mean scores for the EAAM acculturation dimension subscales were as follows: assimilation, 2.86; separation, 3.71; integration, 4.41; and marginalization, 3.08. The HU-DBI scores were based on a 5-point Likert scale with 12 items for a maximum total of 12.0 points. The mean HU-DBI score was 3.16. Pearson correlation analysis indicated that there were no significant associations ($p \geq 0.05$) between the HU-DBI and the 4 EAAM subscale

scores (Table 3).

The independent samples t-test analysis identified no significant difference in the HU-DBI scores based on gender (p = 0.555) and no significant difference in the EAAM acculturation dimension subscales (assimilation, 0.138; separation, 0.692; integration, 0.585; marginalization, 0.848) based on gender. Likewise, no statistically significant differences were found in the HU-DBI scores based on language spoken at home (p = 0.678) or place of education (p = 0.706). However, there were significant differences in EAAM subscale scores for assimilation (p = 0.006), separation (p = 0.002), and integration (p = 0.021) between those who reported speaking either English or Japanese at home. In regard to place of education, there were statistically significant differences in separation (p = 0.020) and integration (p = 0.006) between participants who completed their education in Japan versus those who were educated in both Japan and Canada (Table 4).

Analysis of the relationship between the EAAM scores and demographic and socioeconomic ordinal variables (Table 5) revealed that education level was significantly associated with assimilation (r_s = 0.302, p = 0.041), integration (r_s = 0.314, p = 0.036), and marginalization (r_s = 0.360, p = 0.013). Self-reported English proficiency was negatively associated with separation (r_s = –0.291, p = 0.045) and positively associated with integration (r_s = 0.557, p = 0.001). Pearson correlational analyses indicated that age was the only other demographic variable

Table 1. Participant demographic and socioeconomic responses

Variables	Level/Category	N = 48	%
Gender	Male	13	27.1
	Female	35	72.9
Age	Mean age 39 years, SD = 8.4, range 19–58 years		
Language at home	English	15	31.3
	Japanese	32	66.7
	No response	1	2.1
Other language spoken at home	No	28	58.3
	Yes, English	12	25.0
	Yes, Japanese	7	14.6
	Other	1	2.1
Self-reported English proficiency	Fair	21	43.8
	Good	23	47.9
	Excellent	4	8.3
Years in Canada	Less than 5 years	11	22.9
	Between 5 and 9 years	13	27.1
	Between 10 and 14 years	8	16.7
	Over 15 years	16	33.3
Age immigrated	Less than 25 years old	16	33.3
	Between 25 and 34 years old	30	62.5
	Between 35 and 44 years old	1	2.1
	Over 45 years old	1	2.1
Highest education	High school, but no diploma	1	2.1
	High school diploma	9	18.8
	Trade certificate	4	8.3
	Some college or university courses but no diploma or degree	11	22.9
	College or university certificate or diploma	3	6.3
	University bachelor's degree	18	37.5
	University master's degree or above	2	4.2
Place of education completed	Japan	34	70.8
	Canada	1	2.1
	Both Japan and Canada	12	25.0
	Other	1	2.1
Annual income	Less than $20,000	3	6.3
	Between $20,000 and $50,000	13	27.1
	Between $50,000 and $80,000	7	14.6
	Above $80,000	10	20.8
	I would rather not answer	14	29.2
	No response	1	2.1

Table 2. Summary of EAAM acculturation dimension scores and HU-DBI score

Instrument	Total points	N	Mean	Median	SD
EAAM—Assimilation	7.0	46	2.86	2.94	0.82
EAAM—Separation	7.0	48	3.71	3.71	0.92
EAAM—Integration	7.0	45	4.41	4.20	1.14
EAAM—Marginalization	7.0	47	3.08	3.11	0.99
HU-DBI	12.0	48	3.16	3.13	0.35

Table 3. Relationships between EAAM dimension subscales and HU-DBI scores

Variable	By EAAM dimension	Correlation	N	*p*
HU-DBI	Assimilation	0.074	46	0.626
HU-DBI	Separation	0.087	48	0.554
HU-DBI	Integration	0.045	45	0.768
HU-DBI	Marginalization	−0.219	47	0.139

found to be significantly associated with any of the EAAM dimension scales. A significant negative correlation was identified between age and assimilation (r_s = −0.392, p = 0.012). No significant relationships were identified between EAAM scores and years in Canada or age at immigration.

Spearman correlational analyses of the relationship between demographic and socioeconomic variables and the HU-DBI indicated no significant relationship existed; income was the only ordinal variable trending towards a significant association with the HU-DBI (r_s = 0.287, p = 0.050). Pearson correlational analyses identified no significant associations between age, years in Canada or age at immigration and the HU-DBI (Table 6).

Previous studies have suggested using multivariate analysis of acculturation outcomes and oral health measures.[3] Multiple linear regression analysis included the 4 EAAM dimension scores as predictor variables, and the HU-DBI score was the dependent variable based on the hypothesis predicting an association between acculturation and oral health behaviours and attitudes. Marginalization (p = 0.022) was the only significant predictor of HU-DBI, with a negative Beta or regression weight; however, separation (p = 0.051) was suggestive of being a predictor of HU-DBI, with a positive Beta or regression weight (Table 7).

Table 4. Differences in EAAM dimension scores and HU-DBI scores based on gender, language spoken at home, and place of education

	Gender						
	Male		Female				
	Mean	SD	Mean	SD	*p*	*t*	*df*
Assimilation	2.58	0.89	2.98	0.77	0.138	1.51	44
Separation	3.80	0.93	3.68	0.92	0.692	0.40	46
Integration	4.26	1.07	4.47	1.18	0.585	−0.55	43
Marginalization	3.03	1.23	3.09	0.91	0.848	−0.19	45
HU-DBI	3.11	0.26	3.18	0.38	0.555	−0.60	46
	Language spoken at home						
	English		Japanese				
	Mean	SD	Mean	SD	*p*	*t*	*df*
Assimilation	3.33	0.68	2.63	0.80	0.006[a]	2.89	43
Separation	3.12	0.82	3.99	0.86	0.002[a]	−3.28	45
Integration	5.00	1.27	4.13	1.00	0.021[b]	2.40	42
Marginalization	2.95	1.04	3.12	0.99	0.593	−0.54	44
HU-DBI	3.18	0.54	3.13	0.28	0.678	0.42	45
	Place of education						
	Japan		Japan and Canada				
	Mean	SD	Mean	SD	*p*	*t*	*df*
Assimilation	2.78	0.83	3.01	0.80	0.418	−0.82	43
Separation	3.89	0.80	3.17	1.13	0.020[b]	2.42	44
Integration	4.14	1.08	5.22	0.99	0.006[a]	−2.92	42
Marginalization	3.04	1.02	3.04	0.97	0.997	−0.00	43
HU-DBI	3.14	0.36	3.19	0.33	0.706	−0.38	44

[a]significant at 0.01 level
[b]significant at 0.05 level

Table 5. Relationship between EAAM dimension scores and demographic variables

Score	Demographic variable	Correlation coefficient	N	*p*
		Spearman (r_s)		
Assimilation	Education level	0.302[a]	46	0.041[a]
	Income	0.129	45	0.397
	English proficiency	0.125	46	0.407
Separation	Education level	−0.236	48	0.107
	Income	0.169	47	0.255
	English proficiency	−0.291[a]	48	0.045[a]
Integration	Education level	0.314[a]	45	0.036[a]
	Income	−0.051	44	0.744
	English proficiency	0.557[b]	45	0.001[b]
Marginalization	Education level	0.360[a]	47	0.013[a]
	Income	0.035	46	0.815
	English proficiency	−0.120	47	0.423
		Pearson (r)		
Assimilation	Age	−0.392[a]	40	0.012 [a]
	Time in Canada	−0.243	46	0.103
	Age at immigration	−0.094	46	0.533
Separation	Age	0.006	40	0.973
	Time in Canada	0.129	48	0.384
	Age at immigration	0.222	48	0.130
Integration	Age	−0.152	38	0.363
	Time in Canada	−0.163	45	0.286
	Age at immigration	−0.152	45	0.319
Marginalization	Age	0.010	39	0.954
	Time in Canada	−0.082	47	0.585
	Age at immigration	0.178	47	0.232

[a]Correlation is significant at the 0.05 level (2-tailed)
[b]Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

Gao and McGrath recommended studies of oral health behaviour and diseases using refined acculturation scales to improve the understanding of the course of immigrants' oral health along the acculturation continuum.[3] The present study addressed that recommendation, specifically in Japanese immigrants in Vancouver, Canada. The Japanese community is highly concentrated and fast growing in this locale.[21]

Analysis identified significant differences in acculturation between those who reported speaking English or Japanese at home and place of education. As one might expect, the data showed that assimilated and integrated Japanese immigrants reported speaking English at home. Japanese immigrants who spoke Japanese at home scored higher in separation, indicating a reconfirmation of traditional culture. Likewise, the separation dimension

Table 6. Relationships between HU-DBI scores and demographic variables

Variable	By variable	Correlation coefficient	N	*p*
Spearman (r_s)				
HU-DBI	Education level	−0.135	48	0.360
	Income	0.287[a]	47	0.050[b]
	English proficiency	0.069	48	0.642
	Assimilation	0.074	46	0.626
	Separation	0.087	48	0.554
	Integration	0.045	45	0.768
	Marginalization	−0.219	47	0.139
Pearson (r)				
HU-DBI	Age	−0.159	40	0.328
	Time in Canada	−0.030	48	0.838
	Age at immigration	−0.062	48	0.676

[a]Correlation is significant at the ≤0.05 level (2-tailed)
[b]Trending towards significance at 0.05

was more predominant among Japanese immigrants who completed their education only in Japan. However, Japanese immigrants who were educated in both Japan and Canada integrated themselves into both Canadian and Japanese cultures.

An analysis of the relationship between EAAM and demographic and socioeconomic variables identified self-reported English proficiency as being negatively associated with separation and positively associated with integration. However, the positive correlation between English proficiency and integration (≤0.01 level) was stronger than the negative correlation between English proficiency and separation (≤0.05 level). This finding suggests that, although participants with higher English proficiency were integrated into both Canadian and Japanese cultures, Japanese immigrants with lower English skills remained separated (reconfirming traditional culture). Significant relationships were also found between education level and acculturation. Participants who were more educated were assimilated into Canadian culture and integrated into both Canadian and Japanese cultures. Surprisingly, participants who had completed higher education degrees were correspondingly marginalized and isolated from both cultures. This finding supports previous conclusions from Mariño et al. that acculturation was related to level of education.[9] While income was not significantly associated with any of the acculturation dimensions, it tended towards significant association with oral health behaviours and attitudes. Accordingly, Calvasina et al. reported that immigrants who had no dental insurance and low annual household incomes were more likely to report unmet dental care needs than those with dental insurance and higher incomes.[17]

Age was inversely related to assimilation into Canadian culture. Younger participants were more assimilated into Canadian culture than older immigrants. Previously, Mariño et al. identified that acculturation, as measured by language, country of birth, age at immigration, and length of residence, was positively associated with oral health, yet our findings reveal that time in Canada and age at the time of immigration were not significantly associated with any of the acculturation dimensions.[9] This finding is contradictory to Barry's results, which indicated that length of stay in the host country was positively associated with assimilation and integration and negatively associated with marginalization.[8] Differences in findings related to demographics may be due to the smaller sample size used for our study. Further, the independent samples t-test analyses demonstrated no significant differences in levels of acculturation or oral hygiene behaviours and attitudes based on gender. These results support Barry's findings indicating no association between gender and the 4 acculturation scales. However, several previous studies have shown that women had better dental knowledge and better oral health behaviours than men.[10-12,27]

Multiple regression analysis revealed that marginalization was a significant negative predictor of the HU-DBI while holding other variables constant. The higher the marginalization, the lower the HU-DBI; in other words, participants who felt no attachment to either culture had poorer oral hygiene attitudes and behaviours. It is possible that marginalized Japanese immigrants rejected the new culture's health behaviours or that they maintained their traditional medicine practices. Conversely, as separation appeared to be a positive predictor, those who rejected the new culture were likely to report better oral hygiene attitudes and behaviours. Studies of East Asian immigrants to Canada have documented continued use of traditional medicine practices after immigration, so separated Japanese immigrants may have perceived and reported more positive oral health behaviours and attitudes based on traditional health beliefs.[19,20] Given the small sample size, there was probably not adequate power to confirm this variable as statistically significant at the ≤0.05 level. These multivariate analysis findings suggest an inter-relationship between acculturation and oral health behaviours and attitudes, despite no significant association found using correlational analyses. These findings also support the recommendation by Gao and McGrath to incorporate a multidimensional acculturation scale (a bidirectional rather than unidirectional model of acculturation) and to utilize multivariate analytical approaches to study the complex relationship between acculturation and oral

Table 7. Parameter estimates and significance tests for model predicting HU-DBI from EAAM subscales

Model	Beta coefficient	*t*	*p*
Constant		4.60	0.001
Assimilation	0.157	0.89	0.381
Separation	0.465	2.01	0.051[a]
Integration	0.217	0.95	0.346
Marginalization	–0.432	–2.40	0.022[b]

Dependent variable: HU-DBI
[a]Suggestive of a prediction at 0.051
[b]Significance prediction at <0.05 level

health behaviours.[3] Based on these findings, the hypothesis formulated for this study sample was supported.

As mentioned previously, there are disparities in the oral health of immigrant and non-immigrant populations in Canada.[22] Because dental hygienists are responsible for reducing barriers to care for ethnic minorities by providing culturally appropriate care, knowledge of acculturation may provide essential information for public health programs and practitioners. The findings of this pilot study, coupled with those of other studies focusing on Chinese and Japanese immigrants in various North American cities, provide insight into specific acculturation and oral health behaviour patterns in these communities.

In addition, dental hygienists can increase their awareness of potentially poorer oral health behaviours and attitudes among Japanese immigrants who are less acculturated and have lower incomes. This study's findings address priorities identified in the recently released *2015–2018 CDHA Dental Hygiene Research Agenda* calling for studies of low-income populations.[28] Researchers and dental professionals may be able to identify factors that influence different patterns of acculturation such as age, income, language spoken at home, education levels, and time in Canada, and are linked to specific oral health behaviours and attitudes, leading to an improvement in culturally related oral health behaviours and attitudes of ethnic minority groups.

Understanding the limitations of this study is necessary to accurately interpret and apply the results. This cross-sectional study did not examine relationships between acculturation and oral health behaviours and attitudes over time. The non-probability sample recruited from Greater Vancouver was not representative of the entire Japanese immigrant population in BC or Canada. The distribution of gender in this sample might have influenced the results. In addition, the non-probability convenience sample may result in ascertainment bias, which can lead to a sample different from the target populations. The size of the sample (N=48) may not have been large enough to fully represent characteristics of the population, although the size was adequate for statistical power. Furthermore, because the study included only first-generation Japanese immigrants who were able to speak and understand English, the results may not reflect findings from people who did not speak and understand English, but who may have contributed valuable information to the study.

CONCLUSION

Dental hygienists may help to reduce oral health disparities by advocating for policy changes, performing preventive interventions, and providing oral health education not only to the general public, but also to other health care professionals who deliver their services to underserved populations. Based on the results of this study, it appears that particular attention may need to be paid to groups of Japanese immigrants who are less assimilated into Canadian culture, and to economically disadvantaged Japanese immigrants. Japanese immigrant communities in Canada are growing faster than the overall population. Additional research evaluating the factors that might influence a relationship between acculturation and oral health status is needed. Oral health education in dental hygiene practice and public health programs should target Japanese immigrants, with special consideration given to those who are less acculturated and have lower incomes.

REFERENCES

1. Redfield R, Linton R, Herskovits MJ. Memorandum for the study of acculturation. *Am Anthropol.* 1936;38:149–52.
2. Lassetter JH, Callister LC. The impact of migration on the health of voluntary migrants in western societies. *J Transcult Nurs.* 2009;20(1):93–104.
3. Gao S, McGrath C. A review on the oral health impacts of acculturation. *J Immigr Minor Health.* 2011;13:202–13.
4. O'Driscoll T, Banting LK, Borkoles E, Eime R, Polman R. A systematic literature review of sport and physical activity participation in culturally and linguistically diverse (CALD) migrant populations. *J Immigr Minor Health.* 2014;16(3):515–30. doi: 10.1007/s10903-013-9857-x.
5. Delavaril M, Sønderlund AL, Swinburnl B, Mellor D, Renzaho A. Acculturation and obesity among migrant populations in high income countries – a systematic review. *BMC Public Health.* 2013;13:458. doi: 10.1186/1471-2458-13-458.
6. Afable-Munsuz A, Mayeda ER, Pérez-Stable EJ, Haan MN. Immigrant generation and diabetes risk among Mexican Americans: The Sacramento Area Latino Study on Aging. *Am J Public Health.* 2013;103(5):e45–52. doi: 10.2105/AJPH.2012.300969.
7. Berry JW. Conceptual approaches to acculturation. In: Chun KM, Organista PB, Marín G, editors. *Acculturation: Advances in theory, measurement, and applied research.* Washington, DC: American Psychological Association; 2003. p. 17–37. doi: 10.1037/10472-004.
8. Barry DT. Development of a new scale for measuring acculturation: The East Asian acculturation measure (EAAM). *J Immigr Health.* 2001;3(4):193–97.

9. Mariño R, Stuart GW, Wright FAC, Minas IH, Klimidis S. Acculturation and dental health among Vietnamese living in Melbourne, Australia. *Community Dent Oral Epidemiol.* 2001;29:107–19.
10. Tada A, Hanada N. Sexual differences in oral health behaviour and factors associated with oral health behaviour in Japanese young adults. *Journal of the Royal Institute of Public Health.* 2004;118:104–09.
11. Morita I, Nakagaki H, Toyama A, Hayashi M, Shimozato M, Watanabe T, et al. Behavioral factors to include in guidelines for lifelong oral healthiness: an observational study in Japanese adults. *BMC Oral Health.* 2006;6:15. doi: 10.1186/1472-6831-6-15.
12. Nakayama Y, Mori M. The relationship between number of natural teeth and oral health behavior in adult Japanese people. *Journal of the National Institute of Public Health.* 2012;61(4):366–73.
13. Kawamura M, Iwamoto Y. Present state of dental health knowledge, attitudes/behaviour and perceived oral health of Japanese employees. *Int Dent J.* 1999;49:173–81.
14. Hsu KJ, Yen YY, Lan SJ, Wu YM, Lee HE. Impact of oral health behaviours and oral habits on the number of remaining teeth in older Taiwanese dentate adults. *Oral Health Prev Dent.* 2013;11(2):121–30. doi: 10.3290/j.ohpd.a29360.
15. Ueno M, Ohara S, Inoue M, Tsugane S, Kawaguchi Y. Association between education level and dentition status in Japanese adults: Japan public health center-based oral health study. *Community Dent Oral Epidemiol.* 2012;40:481–87.
16. Cruz GD, Chen Y, Salazar CR, Le Geros RZ. The association of immigration and acculturation attributes with oral health among immigrants in New York City. *Am J Public Health.* 2009;99(52):S474–80.
17. Calvasina P, Muntaner C, Quiñonez C. Factors associated with unmet dental care needs in Canadian immigrants: An analysis of the longitudinal survey of immigrants to Canada. *BMC Oral Health.* 2014;14:145. doi: 10.1186/1472-6831-14-145.
18. Saito A, Kikuchi M, Ueshima F, Matsumoto S, Hayakawa H, Masuda H, et al. Assessment of oral self-care in patients with periodontitis: A pilot study in a dental school clinic in Japan. *BMC Oral Health.* 2009;9:27. doi: 10.1186/1472-6831-9-27.
19. Dong M, Loignon C, Levine A, Bedos C. Perceptions of oral illness among Chinese immigrants in Montreal: A qualitative study. *J Dent Edu.* 2007;71(10):1340–47.
20. Smith A, MacEntee MI, Beattie BL, Brondani M, Bryant R, Graf P, et al. The influence of culture on the oral health-related beliefs and behaviours of elderly Chinese immigrants: A meta-synthesis of the literature. *J Cross Cult Gerontol.* 2013;28(1):27–47.
21. Lindsay C. Profiles of ethnic communities in Canada. The Japanese community in Canada. *Statistics Canada. Social and Aboriginal Statistics Division.* 2001. Catalogue no.89-621-XIE.
22. Asadoorian J. Inequity and disparity in oral health – Part II. Socio-economic status and deprivation: can dental hygiene diminish the impact? *J Dent Hyg.* 2009;43(2):53–59.
23. Canadian Dental Hygienists Association. *Dental Hygiene Research agenda.* Ottawa: CDHA; 2003, revised 2009. Available from http://www.cdha.ca/pdfs/Profession/Policy/research_agenda_102603.pdf
24. Kawamura M. Dental behavioral science: The relationship between perceptions of oral health and oral status in adults. *Journal of Hiroshima University Dental Society.* 1988;20:273–86.
25. Kawabata K, Kawamura M, Miyagi M, Aoyama H, Iwamoto Y. The dental health behavior of university students and test-retest reliability of the HU-DBI. *J Dent Health.* 1990;40:474–75.
26. Kawamura M, Sasahara H, Kawabata K, Iwamoto Y, Konishi K, Wright FAC. Relationship between CPITN and oral health behaviour in Japanese adults. *Aust Dent J.* 1993;38(5):381–88.
27. Petersen PE, Jiang H, Peng B, Tai BJ, Bian Z. Oral and general health behaviours among Chinese urban adolescents. *Community Dent Oral Epidemiol.* 2008;36:76–84.
28. Canadian Dental Hygienists Association. *2015–2018 Dental hygiene research agenda.* Ottawa: CDHA; 2016. Available from http://files.cdha.ca/profession/research/DHResearchAgenda_EN.pdf

Examining changes in income-related oral health inequality in Canada: A population-level perspective

Julie Farmer[*], MSc, RDH; **Logan McLeod**[§], PhD; **Arjumand Siddiqi**[ǂ], MPH, ScD; **Vahid Ravaghi**[Δ], DDS, MSc, PhD; **Carlos Quiñonez**[*] DMD, MSc, PhD

ABSTRACT

Introduction: Monitoring trends in oral disease is essential to identifying population needs and informing policies to improve the oral health status of Canadians. At present, effort to examine income-related inequalities in untreated dental disease, such as dental decay, and their changes over time has been minimal in Canada. This article examines and compares income-related inequalities in decayed teeth in Canada between the 1970s and 2000s. **Methods:** A secondary data analysis using the Nutrition Canada National Survey 1970–1972 and the Canadian Health Measures Survey 2007–2009 was performed in order to examine individual- and population-level income-related inequalities in dental decay. Income quintiles and concentration indices for the presence of one or more decayed teeth were derived using indirect standardization and multivariate logistic regression. **Results:** Results highlight that income gradients in decayed teeth have persisted over time, with higher income groups experiencing greater reductions in the prevalence of decayed teeth than those of lower income. Higher concentration indices exhibited in more recent surveys suggest an increase in income-related inequality in decayed teeth over time. **Conclusion:** Our findings provide a foundation for measuring changes to income-related inequalities in oral disease in the Canadian population and reveal that inequalities in decayed teeth have persisted despite overall reductions in the presence of dental decay over time.

RÉSUMÉ

Contexte : La surveillance des tendances en matière des maladies buccodentaires permet de cerner les besoins de la population et d'influencer la politique en vue d'améliorer l'état de santé buccodentaire des Canadiens. À ce jour, les efforts pour examiner les inégalités liées au revenu en matière des maladies dentaires non traitées et leurs changements au fil du temps ont été minimes au Canada. Nos objectifs étaient d'examiner et de comparer les inégalités liées au revenu au Canada, en matière de dents cariées, entre les années 1970 et les années 2000. **Méthodes :** Une analyse de données secondaires à l'aide de l'Enquête nationale sur la nutrition au Canada 1970–1972 et l'Enquête sur la santé canadienne 2007–2009 a été réalisée afin d'examiner les inégalités en matière de santé buccodentaire liées au revenu individuel et à celui de la population. Les quintiles de revenus et les indices de concentration concernant la présence d'une ou de plusieurs dents cariées ont été obtenus à l'aide de la standardisation indirecte et de la régression logistique multivariée. **Résultats :** Les gradients de revenu en matière de santé buccodentaire ont persisté à travers le temps, se traduisant en une plus importante réduction de dents cariées dans les quintiles de revenu plus élevés que dans les quintiles de revenu plus faibles. Des indices de concentration plus élevés ont été exposés dans des enquêtes plus récentes, ce qui suggère qu'il existe une augmentation des inégalités liées au revenu en matière de dents cariées au fil du temps. **Conclusion :** Nos résultats fournissent un indice de référence pour mesurer les variations des inégalités liées au revenu en matière de santé buccodentaire de la population canadienne et ils révèlent que les inégalités sur le plan des maladies dentaires non traitées ont persisté au fil du temps malgré la réduction du taux de caries.

Key words: concentration index, dental caries, dental disease, health inequalities, population health

INTRODUCTION

Monitoring trends in oral disease is essential to identifying population needs and informing policies to improve the oral health status of Canadians. With oral health care predominantly privately financed in Canada, it is essential to monitor trends and inequalities related to the affordability of care. Income gradients in oral health and disease are well recognized internationally; they are described as poorer oral health status and access to care with diminishing income.[1] At present, effort to examine income-related inequalities in oral health and disease outcomes in Canada and their changes over time has been minimal.

Indeed, only one study has examined changes to oral health inequalities in Canada. Elani and colleagues measured the difference in the prevalence of one or more decayed, filled, and missing teeth outcomes by income and concluded a narrowing of inequality among income groups since the 1970s.[2] Although these results provide insight into the changes in the level of oral health and disease by income group, they do not accurately depict changes to the

[*]Discipline of Dental Public Health, Faculty of Dentistry, University of Toronto, Toronto, ON
[§]Department of Economics, Lazaridis School of Business & Economics, Wilfrid Laurier University, Waterloo, ON
[ǂ]Dalla Lana School of Public Health, University of Toronto, Toronto, ON
[Δ]School of Dentistry, University of Birmingham, Birmingham, England, UK

Correspondence to: Julie Farmer; julie.farmer@mail.utoronto.ca
Submitted 11 April 2016; revised 17 May 2016; accepted 20 May 2016

level of inequality experienced in the Canadian population, as income group size and the distribution of income across the population were not taken into account.[3] Fortunately, a number of summary measures of health inequalities have emerged to address this issue. One popular measure is known as the concentration index method, as it measures the size of inequality in oral health or disease from a population-level perspective and accounts for these limitations.[4] The concentration index describes how equally or unequally an oral health or disease outcome is distributed across a population and can be used to examine and compare inequality over time or between regions.[4]

Using the concentration index method, researchers have identified income-related inequalities in access to dental care and clinical outcomes in Canada. Allin found that dental visits within the past year were more concentrated among higher income individuals in all provinces, indicating income as a predictor of inequalities in dental care visits.[5] Moreover, income-related inequality in preventive dental care was found to be unequally concentrated among higher income groups, indicating that the rich had a greater share of reported preventive dental visits within the past year than the poor.[6] Clinical outcomes have also been used to examine inequalities in treated (filled teeth) and untreated (decayed teeth) dental disease as well as endpoints of disease (missing teeth).[7] Indeed, Ravaghi and colleagues identified higher income-related inequalities in decayed and missing teeth than in filled teeth, concluding that lower income groups share a greater burden of disease than higher income groups.[7] Their results suggest that the poor often receive less preventive treatment and postpone curative treatments, potentially leading to the development of more severe oral health problems and more untreated disease in adult Canadian populations.

While there has been significant interest in monitoring trends in health inequalities in Canada, oral health outcomes are rarely identified in these reports.[8,9] Importantly, examining changes to the level of income-related inequality in preventable dental disease, such as dental decay, provides insight for dental professionals into potential affordability barriers to timely care. Although there have been improvements in the overall prevalence of oral disease in the Canadian population since the 1970s, it is not known if this has translated to a reduction in inequality at the population level.[10] As such, this article examines and compares income-related inequalities in decayed teeth in Canada between the 1970s and 2000s.

METHODOLOGY

A secondary data analysis of 2 Canadian cross-sectional national surveys was performed in order to examine individual- and population-level income-related inequalities in dental decay. Analysis focused on individuals ages 20 to 74 years; those who were younger than 20 or over 75 years of age, did not complete household questionnaires and/or clinical examinations, and/or had missing data were excluded.

Data sources

Data come from 2 Canadian sources: 1) the Nutrition Canada National Survey 1970–1972 (NCNS); 2) the Canadian Health Measures Survey 2007–2009 (CHMS). The NCNS was accessed through Statistics Canada's Data Liberation Initiative (DLI). The CHMS was accessed through the Statistics Canada Research Data Centre (RDC) at the University of Toronto.

The NCNS was conducted between October 1970 and September 1972. The survey collected information from 19,590 individuals ages 0 to over 100. The survey attempted to estimate the prevalence of nutritional diseases in the Canadian population and determine food type and quantity consumed by Canadians by collecting representative estimates from metropolitan, urban, and rural residents and from low and other income groups. The following 5 regions were represented in the sampling: Atlantic (Newfoundland, Prince Edward Island, New Brunswick, and Nova Scotia); Quebec; Ontario; Prairie (Manitoba, Saskatchewan, and Alberta); and British Columbia. Aboriginal groups living on reserves or Crown lands in the following regions were also sampled: Maritime (PEI, New Brunswick, and Nova Scotia); Quebec; Ontario; Prairie (Manitoba, Saskatchewan, and Alberta); British Columbia; Yukon and Northwest Territories, as were Inuit living in 4 settlements in the Northwest Territories. With the exception of the samples of expectant women and phase I of the youth survey, the survey was statistically designed to produce probability samples. Data were collected in two phases: 1) household interview; 2) clinical examination at the Nutrition Canada Clinic. Household interviews captured general demographic, socioeconomic, food handling, and food preparation information. Several clinical measures were used in the Nutrition Canada Clinic, including oral health measures. The final NCNS produced a nationally representative sample of 14,245 dental records.[11]

The CHMS was conducted by Statistics Canada between March 1, 2007, and March 31, 2009, and collected information from household residents ages 6 to 79 years. Collection occurred in 2 stages: 1) household interview; 2) clinical examination. The household interview collected information on respondents' demographic characteristics, socioeconomic status, and health behaviours. The clinical examination collected clinical measures of respondents' physical health (including an oral health examination). The clinical examination was conducted in a CHMS mobile examination centre. The oral health examination involved direct physical measurements of oral health by calibrated dentists/examiners using a mouth mirror and explorer. Of the 8,772 households selected for the CHMS, 69.6% agreed to participate; 88.3% of them responded to the household interview, and of those, 84.9% visited the mobile examination centre. The overall response rate was

51.7%. A comprehensive consent process was employed. The final CHMS sample size was 5,604 respondents, which is representative of approximately 96.3% of the Canadian population.

Data variables

The presence of decayed teeth—a measure of untreated dental disease—was clinically recorded in both surveys. The concentration index method requires a ranked measure of socioeconomic status; income is the measure of socioeconomic status in our analysis, and was recoded into quintile groups based on each survey's income distribution. Sociodemographic variables of sex, age, and education were used as controls for analysis of income-related oral health inequalities. For consistency between surveys, respondents were categorized into the following age groups: young adults (20–39), middle-aged adults (40–59), and older adults (60–74). Education was reported as the highest level of education achieved by the head of household and dichotomized to "less than high school" and "high school" due to differences in reporting between surveys.

Description of the concentration index

The concentration index (CI) is a method adapted from the concepts of the Lorenz curve and Gini index. As identified in Figure 1a, the Lorenz curve plots the cumulative proportion of individuals by level of health, ranked in increasing order on the x-axis, against the cumulative total proportion of health within these individuals on the y-axis. The diagonal line identifies an equal distribution of health across a population. A Lorenz curve deviating from the diagonal line indicates that health is unequally distributed across individuals because some individuals are healthier than others.[3] The Gini index measures the distance of the Lorenz curve from the diagonal line. The Gini index is represented as a value ranging from 0 (diagonal line) to 1 (health is concentrated in a single person).

Similarly, the CI measures the distribution of a health outcome across socioeconomic levels within a population. The CI is derived from a concentration curve (CC) that plots the cumulative proportion of the population ranked by socioeconomic status from lowest to highest against the cumulative proportion of the health outcome (Figure 1b). Again, a diagonal line represents the line of equality. Deviations of the CC above or below the diagonal line indicate inequality, where the farther the CC is from the diagonal, the greater the degree of inequality. If the CC falls under the diagonal line, as exhibited in Figure 1b, the outcome is concentrated in those with higher socioeconomic status; if the CC is above the diagonal line, the outcome is concentrated in those with lower socioeconomic status.

The CI measures the distance of the CC from the diagonal line. The CI can take a value ranging from −1 to +1. If all health is concentrated in the person with the highest socioeconomic level, the CI will have a value of

Figure 1a. Lorenz curve

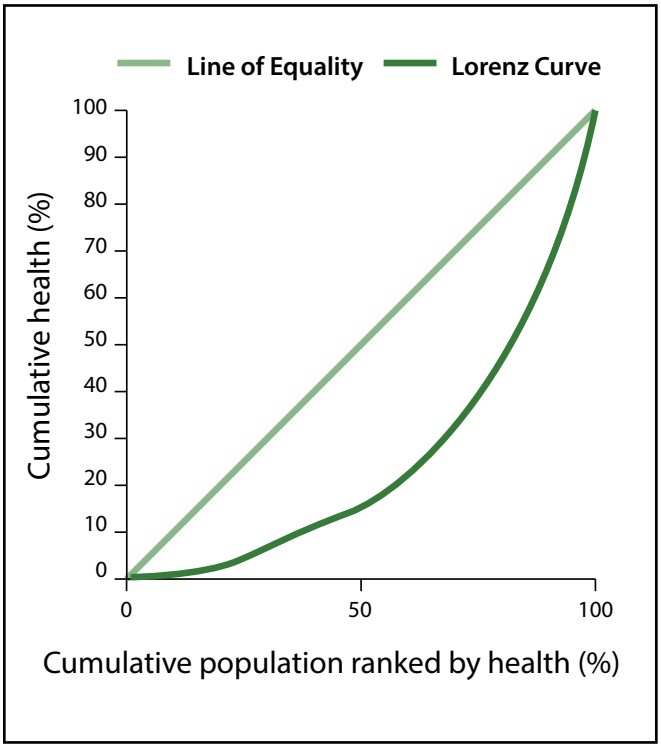
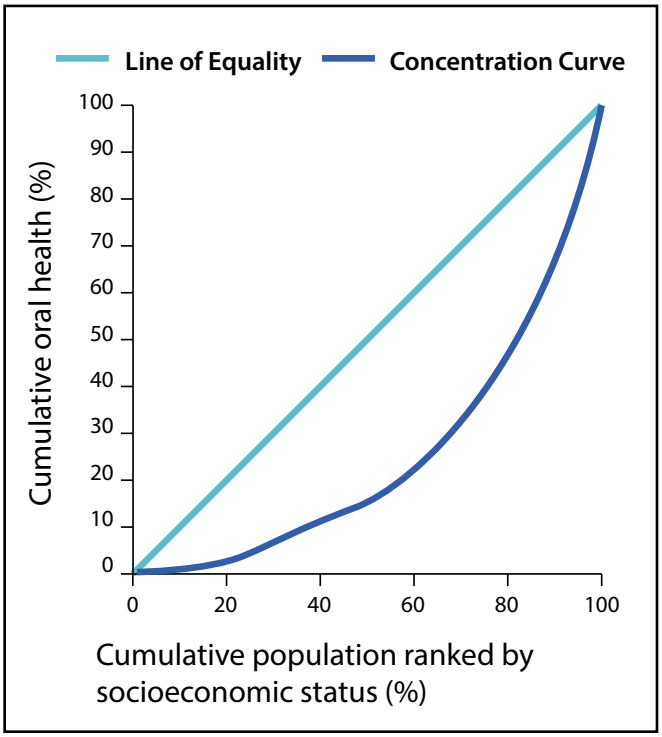


Figure 1b. Concentration curve



+1. If health is concentrated in the person with the lowest socioeconomic level, the CI will have a value of −1. Therefore, the closer the CC is to the diagonal line and the closer the CI is to 0, then the greater the equality in that outcome.

For binary outcomes the possible values of the CI are limited by the mean (p) of the distribution and are equal to p-1 and 1-p, respectively.[12] As the mean increases, the range of possible values of the CI shrinks, which has implications for judging the outcomes of binary variables. Therefore, to permit comparison of the concentration index for binary outcomes, the CI can be normalized so that the bounds will be between −1 and +1.[12]

Using convenient linear regression methods, observed and expected CIs were derived and normalized for the presence of one or more decayed teeth for each survey. Observed CIs indicate the magnitude of inequality in decayed teeth experienced in the population, whereas expected CIs reflect the predicted magnitude of inequality in decayed teeth taking into account confounding variables. To produce expected CIs, we controlled for age, sex, education, and income through indirect standardization using multivariate logit models.[4] The difference between the observed and expected CIs was subsequently calculated in order to measure avoidable inequality in decayed teeth, which is interpreted as the level of inequality remaining after accounting for confounding variables.[4] The independent samples t-test was used to determine statistical significance of differences in avoidable inequality between surveys.[13,14] To account for complex survey design and probability sampling, survey weights in each dataset were included in all analyses.

Variations in survey design and methodology between the NCNS and CHMS were limitations of our analyses. Although each survey collected demographic, socioeconomic, and oral health information to produce nationally representative estimates, the degree and availability of comparable outcome and explanatory variables were limited. For example, outcome variables, such as access to dental care and treatment needs, and explanatory variables, such as dental insurance, type of dental insurance, rural/remote location, occupational status, oral hygiene behaviours, were not consistently reported. In addition, because of differences in reporting educational attainment between surveys, our analyses were limited to adult populations. The NCNS reported education based on participants interviewed rather than head of household. As a result, individuals who were ineligible, due to age, to complete high school education were excluded.

RESULTS

Descriptive statistics for the analysis samples are presented in Table 1. The majority of the participants in both surveys fell into the young adult and middle-aged adult categories (20–59), with equal representation between sexes and across income quintiles. There was greater representation of participants with higher educational attainment (high school graduate) in the 2000s compared to the 1970s. As well, there was no statistically significant difference between survey samples.

Table 1. Summary statistics for analysis sample (%)

		Canada 1970–1972 (n = 10,411)	Canada 2007–2009 (n = 3,313)
Age	20–39 years	55.8	39.3
	40–59 years	31.9	42.8
	60–74 years	12.3	17.9
Sex	Female	53.2	49.4
	Male	46.8	50.6
Income	Lowest	10.6	23.8
	Lower middle	23.6	18.9
	Middle	19.7	16.8
	Upper middle	27.5	12.5
	Highest	18.4	28.0
Education	<High school	69.2	8.9
	>High school	30.8	91.1

The overall prevalence of decayed teeth has declined over time (Figure 2). Income gradients in one or more decayed teeth are well defined, with higher rates reported in lower income quintiles in both years and greater reductions in the prevalence of decayed teeth exhibited in higher income quintiles over time.

Table 2 provides the CIs for both surveys, where negative CIs reveal that the presence of decayed teeth is concentrated among the poor. The observed CIs show greater inequality in Canada over time. When standardizing for the characteristics of the population, the expected CIs exhibit a more equal distribution of disease (value closer to 0) across income groups over time. The difference between the actual (observed) distribution of decayed teeth across income and distribution that would be expected given the distribution of need is also shown in Table 2. Thus, our findings reveal a small but statistically significant increase in avoidable inequalities in the presence of one or more decayed teeth in Canada since the 1970s (−0.158 to −0.164).

Table 2. Concentration indices for one or more decayed teeth (weighted)[a]

	Canada 1970–1972			Canada 2007–2009		
	CI	SE	p value[b]	CI	SE	p value[b]
Observed	–0.160	0.037	0.001	–0.167	0.024	<0.001
Expected	–0.002	0.031	0.644	–0.003	0.015	0.809
Avoidable inequality[c] [Observed – Expected]	–0.158	0.008	[d]	–0.164	0.008	[d]

[a]CI=Concentration index, SE=Standard error
[b]p value < 0.05 indicates significant difference from equality (CI = 0)
[c]t-value for independent samples t-test for difference in avoidable inequality in Canada over time (37.60)
[d]Not reported

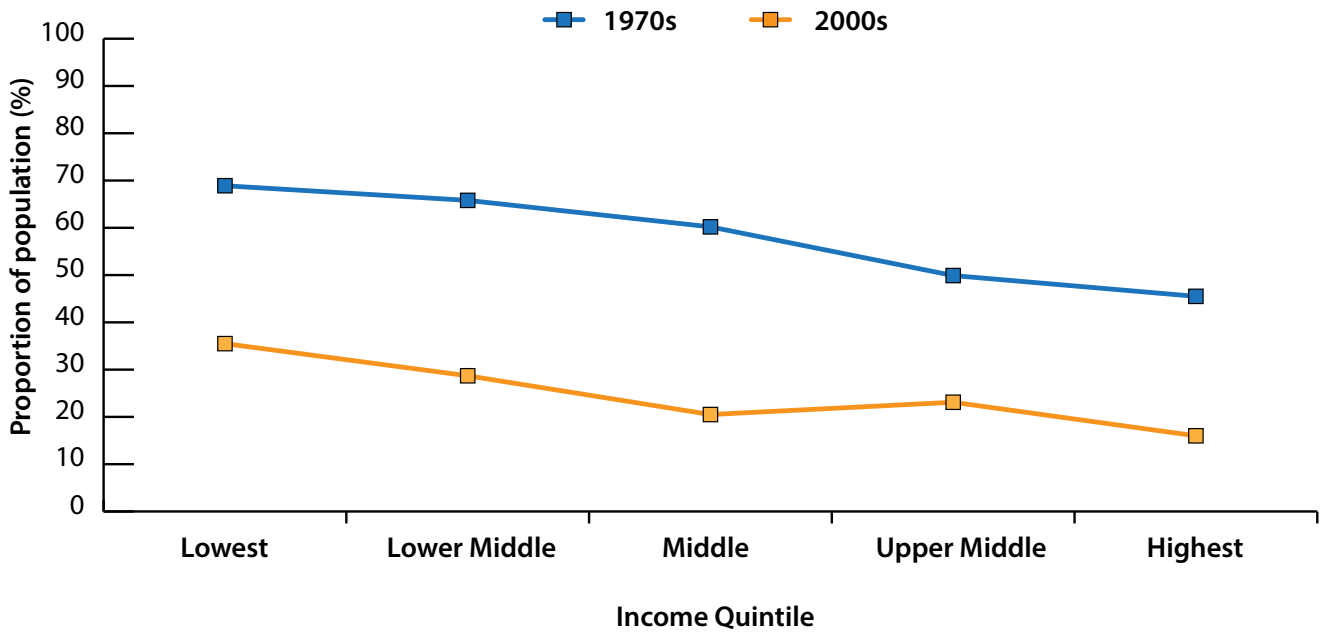
DISCUSSION

This study identified the persistence and magnitude of income-related inequalities in the presence of decayed teeth in Canada since the 1970s. Our results provide estimates and report on changes to individual-level (prevalence estimates by income quintile) and population-level (concentration index) income-related inequality in the presence of one or more decayed teeth over time.

First, this study revealed that the overall prevalence of one or more decayed teeth in the Canadian population has decreased over time. This finding is consistent with existing reports that indicate reductions in the prevalence of oral diseases, such as dental caries, periodontal disease, and edentulism.[10] Our findings also showed that income gradients in oral health have persisted, with greater reductions in the presence of decayed teeth in higher income quintiles than lower quintiles. Indeed, over time the presence of one or more decayed teeth in highest income quintile decreased by more than two thirds, whereas in the lowest income quintile the presence decreased by almost half. These findings corroborate those of Mejia and colleagues, who found that, as the overall prevalence of decayed teeth declines in a population, groups with higher socioeconomic status often experience the sharpest decline compared to lower socioeconomic groups.[15]

Of important note, our results stratified by income show less narrowing of inequality than the study by Elani and colleagues, who examined absolute differences in oral health outcomes by income groups in Canada during the same time period.[2] This discrepancy may be due to different

Figure 2. Income gradients in one or more decayed teeth in Canada



classification methods for income groups (3 groups vs. 5 groups) and differences in confounding variables and methods used to produce prevalence estimates.[2]

Results from our analyses revealed that population-level inequality in one or more decayed teeth has increased over time. This coincides with trends in income-related inequalities in health outcomes in Canada. A report by the Canadian Institute for Health Information (CIHI) revealed persistence and widening of inequalities in health between the rich and the poor over time.[8] The outcomes in the CIHI report included hospitalization associated with chronic obstructive pulmonary disease, heart attacks, and obesity, but did not include oral health. When comparing oral health and general health, Ravaghi and colleagues found greater income-related inequalities in oral health in the Canadian population, which may suggest that, when access to care is dependent on individual financial circumstances, greater income-related inequalities exist.[16] Similar trends were also noted in a study by Allin, who compared physician and dental visits in Canada.[5] Unfortunately, due to lack of information and data collection on access to dental care and oral health outcomes, longitudinal analyses of these inequalities and comparisons to health in Canada are near to impossible.

Our findings also highlight the importance of understanding changes and potential contributors to income-related inequalities in decayed teeth. One explanation for increases in inequality may be changes in the distribution of income in Canada. By using the Gini coefficient, a measure of distribution of income in a population, economists have revealed increases in income-related inequality in Canada since the 1970s; for both before- and after-tax measures of family income, inequality has increased in Canada during that period.[17] In addition, changes in the costs associated with dental care in relation to the amount of disposable income, as well as quality and extent of dental insurance coverage in the Canadian population, may also contribute to these inequalities.[18]

Since the 1970s, public financing of dental care in Canada has declined. While in the 1970s, nearly 20% of dental expenditures were attributed to public funding, that figure has now decreased to 5.6%.[19] Low- and middle-income individuals are often ineligible for employment-based or public dental insurance given their type of employment or level of income,[20] especially when public dental coverage for adults is often limited to recipients of social assistance programs or to the few who meet restrictive low-income eligibility thresholds.[19] Moreover, with shifts towards non-standard precarious employment (such as temporary and part-time work), which has predominantly affected low- and middle-income individuals over the past few decades, the ability to finance dental care depends heavily on individual financial circumstances.[21,22] Therefore, changes in enrollment criteria and eligibility standards for public dental programs, as well as reductions in the costs of private insurance plans and dental services, should be further explored.

As dental care in Canada is predominantly financed through out-of-pocket or private insurance payments, and with cost being reported as a common barrier to accessing dental care, it is critical for public health and dental professionals to explore mechanisms to improve affordability of care. These mechanisms may include changing eligibility requirements for and coverage of dental insurance, increasing salaries and wages, and improving access to a broader range of providers. Alternative care settings, such as community-based dental clinics and mobile dental clinics, or better access to dental hygiene services may help to reduce the costs of care, increase access to preventive services, and ultimately improve oral health.[23]

Merely reducing cost barriers to accessing dental care may not eliminate income-related inequalities. Oral health is the product of a complex interaction between societal and individual factors, over and above access and financial considerations. Therefore, a reduction or elimination of oral health inequalities within a population requires a multifaceted approach that addresses the social determinants of health.

Further research is needed to better understand contributors and approaches to reducing inequality. In 2012, the International Association of Dental Research Global Oral Health Inequalities Steering and Task Group outlined a research agenda on generating evidence to aid in reducing oral health inequalities.[24] Initiatives that align with these research priorities will be valuable for addressing and reducing inequalities; these include exploration into contributors to individual risk for oral disease, components within dental care systems such as the financing, organization, and delivery of dental care in Canada, and their social and political environments.[24]

In conclusion, our findings provide a foundation for monitoring income-related inequalities in decayed teeth in Canada. Ongoing monitoring of oral health outcomes within populations will enable researchers and policy makers to evaluate changes and uncover contributors to inequalities.

ACKNOWLEDGEMENT

Funding for this project was provided, in part, by the Canadian Foundation for Dental Hygiene Research and Education (Contract #CFDHRE-2014-2015-02).

REFERENCES

1. Devaux M, de Looper M. Income-related inequalities in health service utilisation in 19 OECD countries, 2008–2009. *OECD Health Working Papers No. 58.* Paris: OECD Publishing; 2012 Jul 10.
2. Elani HW, Harper S, Allison PJ, Bedos C, Kaufman JS. Socio-economic inequalities and oral health in Canada and the United States. *J Dent Res.* 2012 Sep 1;91(9):865–70.
3. Regidor E. Measures of health inequalities: part 2. *J Epidemiol Community Health.* 2004;(11):900–3.
4. O'Donnell OA, van Doorslaer E, Wagstaff A, Lindelow M. *Analyzing health equity using household survey data: A guide to techniques and their implementation*. Washington, DC: World Bank Publications; 2008.
5. Allin S. Does equity in healthcare use vary across Canadian provinces? *Healthc Policy.* 2008;3(4):83–99.
6. Grignon M, Hurley J, Wang L, Allin S. Inequity in a market-based health system: Evidence from Canada's dental sector. *Health Policy*. 2010 Nov 30;98(1):81–90.
7. Ravaghi V, Quiñonez C, Allison PJ. The magnitude of oral health inequalities in Canada: findings of the Canadian health measures survey. *Community Dent Oral Epidemiol.* 2013 Dec 1;41(6):490–8.
8. Harvey J, Hynes G, Pichora E. Trends in income-related health inequalities in Canada. *Healthc Q.* 2016;18(4):12.
9. Public Health Agency of Canada. *Reducing health inequalities: A challenge for our times.* Ottawa, ON: PHAC; 2011.
10. Health Canada. *Report on the findings of the oral health component of the Canadian Health Measures Survey 2007–2009*. Ottawa, ON: Health Canada; 2010.
11. Canada, Bureau of Nutritional Sciences. *Nutrition Canada dental report: A report from Nutrition Canada by the Bureau of Nutritional Sciences, Food Directorate Health Protection Branch, Department of National Health and Welfare.* Ottawa, ON: Bureau of Nutritional Sciences; 1977.
12. Wagstaff A. The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Econ*. 2005 Apr 1;14(4):429–32.
13. Wagstaff A, Watanabe N. Socioeconomic inequalities in child malnutrition in the developing world. *Policy Research Working Paper 2434*. Washington, DC: World Bank; 1999.
14. Lindelow M. Sometimes more equal than others: How health inequalities depend on the choice of welfare indicator. *Health Econ*. 2006 Mar 1;15(3):263–79.
15. Mejia G, Jamieson LM, Ha D, Spencer AJ. Greater inequalities in dental treatment than in disease experience. *J Dent Res.* 2014 Oct 1;93(10):966–71.
16. Ravaghi V, Quiñonez C, Allison PJ. Comparing inequalities in oral and general health: findings of the Canadian Health Measures Survey. *Can J Public Health*. 2013 Oct 31;104(7):e466–71.
17. Rajotte J. Income inequality in Canada: an overview. *Report of the Standing Committee on Finance.* Ottawa, ON: The Office of the Speaker of the House of Commons; 2013.
18. Sanmartin C, Hennessy D, Lu Y, Law MR. Trends in out-of-pocket health care expenditures in Canada, by household income, 1997 to 2009. *Health reports*. 2014;25(4):13.
19. Quiñonez C, Grootendorst P, Sherret L, Azarpazhooh A, Locker D. *An environmental scan of provincial and territorial public dental programs in Canada*. Toronto, ON: Community Dental Health Services Research Unit, University of Toronto; 2007.
20. Ramraj C, Weitzner E, Figueiredo R, Quiñonez C. A macroeconomic review of dentistry in Canada in the 2000s. *J Can Dent Assoc.* 2014;80:e55.
21. Muirhead VE, Quiñonez C, Figueiredo R, Locker D. Predictors of dental care utilization among working poor Canadians. *Community Dent Oral Epidemiol*. 2009;37(3):199–208.
22. Quiñonez C, Grootendorst P. Equity in dental care among Canadian households. *Int J Equity Health*. 2011 Dec 1;10(1):1–9.
23. Shaefer HL, Miller M. Improving access to oral health care services among underserved populations in the US: Is there a role for mid-level dental providers? *J Health Care Poor Underserved.* 2011 Aug;22(3):740–4.
24. Sgan-Cohen HD, Evans RW, Whelton H, Villena RS, MacDougall M, Williams DM, et al. IADR Global Oral Health Inequalities Research Agenda (IADR-GOHIRA(R)): A call to action. *J Dent Res.* 2013;92(3):209–11.

The impact of occupation-related musculoskeletal disorders on dental hygienists

Courtenay R Johnson *, DipDH, RDH; **Zul Kanji**§, MSc, RDH

ABSTRACT

When compared to other dental professionals, dental hygienists who work in clinical practice may be at higher risk for musculoskeletal disorders (MSDs) due to procedures that involve precise, repetitive motions, as well as awkward and static postures. MSDs encompass a range of injuries that can affect both the hard and soft tissues of the body, typically resulting from repetitive strain and cumulative trauma. The reported one-year prevalence rate of MSDs in dental hygienists ranges from 60% to 96%, with pain most frequently presenting in the neck, shoulder, wrist, hand, and back. To manage their pain, many dental hygienists seek conventional solutions, such as medication and splints, while others turn to complementary and alternative methods, such as massage therapy and yoga. MSDs can become a significant concern for dental hygienists working in clinical practice. Without in-depth knowledge of musculoskeletal health and injuries, as well as preventive and/or coping methods, dental hygienists may be forced to endure daily pain while continuing to work. If the injury is allowed to progress beyond a certain stage, some dental hygienists may have no option but to leave clinical practice. The objective of this literature review is to determine the impact of occupation-related MSDs on dental hygienists who work in clinical practice.

RÉSUMÉ

En comparaison avec d'autres professionnels dentaires, les hygiénistes dentaires qui travaillent en pratique clinique peuvent présenter un risque plus élevé de développer un trouble musculosquelettique (TMS) en raison des procédures, qui demandent des mouvements précis et répétitifs, et des postures maladroites et stationnaires. Les TMS englobent diverses lésions qui peuvent avoir un effet à la fois sur les tissus durs et les tissus mous du corps, et qui sont surtout attribuables aux gestes répétitifs et aux microtraumatismes répétés. Le taux de prévalence à un an des TMS chez les hygiénistes dentaires varie de 60 % à 96 %, la douleur se présentant le plus fréquemment au cou, aux épaules, au poignet, à la main et au dos. Pour gérer leur douleur, plusieurs hygiénistes dentaires ont recours aux solutions classiques, telles que les médicaments et les attelles, tandis que d'autres se tournent vers des méthodes complémentaires et non traditionnelles, comme la massothérapie et le yoga. Les TMS peuvent devenir une grande source d'inquiétude pour les hygiénistes dentaires qui travaillent en pratique clinique. En l'absence de connaissances approfondies sur les blessures et la santé musculosquelettique, ainsi que sur les méthodes de prévention et de maîtrise de la douleur, les hygiénistes dentaires peuvent être contraintes à endurer la douleur quotidienne tout en devant continuer à travailler. Si la blessure progresse au-delà d'un certain seuil, quelques hygiénistes dentaires peuvent ne pas avoir d'autres options que de quitter la pratique clinique. L'objectif de cette analyse documentaire est de déterminer les répercussions des TMS liées à la profession sur les hygiénistes dentaires qui travaillent en pratique clinique.

Key words: cumulative trauma injury, dental, dental hygiene, impact, musculoskeletal, prevalence, prevention, repetitive strain injury, risk factor, therapy, treatment

INTRODUCTION

Dental professionals encounter musculoskeletal pain more often than any other occupational health hazard.[1] Compared to dentists and dental assistants, dental hygienists may be at higher risk,[1-5] due to procedures that involve precise, repetitive motions, as well as awkward and static postures.[2,4,6-16] Musculoskeletal disorders (MSDs) encompass a range of injuries that can affect both hard and soft tissues of the body, typically resulting from repetitive strain and cumulative trauma.[2,7,9] Examples of MSDs include carpal tunnel syndrome, tension neck syndrome, tendonitis, trapezius myalgia, and vibration-induced neuropathy.[2,3,6,12,17,18]

For dental hygienists with MSDs who do not experience positive treatment outcomes, the impact on their health and careers can be significant. Many may be faced with costly and time-consuming options, such as reducing clinical work hours or pursuing further education in order to change practice settings or careers. Performing required clinical responsibilities without adopting appropriate prevention strategies increases the risk of developing an MSD. A study from 2000 revealed that 67% of dentists and 86% of dental hygienists in British Columbia claimed they had experienced musculoskeletal pain within the previous year.[8] More current overall prevalence rates of MSDs in

*Undergraduate student, Dental Hygiene Degree Program, University of British Columbia, Vancouver, BC

This article was written in partial fulfillment of the requirements for the BDSc(DH) degree at the University of British Columbia.

§Director, Dental Hygiene Degree Program, Faculty of Dentistry, University of British Columbia, Vancouver, BC

Correspondence to: Courtenay R Johnson; courtenay.johnson@alumni.ubc.ca

Submitted 1 June 2015; revised 15 October 2015; accepted 10 November 2015

dental hygienists range from 60% to 96%, with pain most frequently presenting in the neck, shoulder, wrist/hand, and back.[2,3,5,7-9,11,19,20]

The purpose of literature reviews is to summarize findings or themes prevalent in the literature while offering a critique of the studies reviewed. Literature reviews are useful educational articles since they pull many pieces of information together and present a comprehensive and broad overview of a specific topic aimed at informing the readership and offering further insight.[21]

The purpose of this literature review is to explore the relationship between occupation-related MSDs and dental hygienists working in clinical practice. It examines studies that focus on MSDs in dental professionals, particularly those that highlight the experience of dental hygienists. This review analyses the signs, symptoms, and impact of these disorders, associated contributing factors, as well as therapeutic methods for preventing and/or alleviating discomfort (Table 1).

METHODS

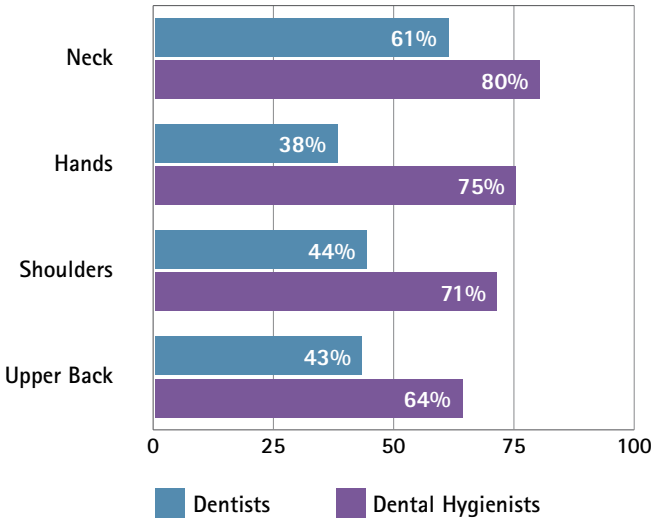
A search of CINAHL, Google Scholar, and PubMed for full-text, peer-reviewed articles published since 1995 was undertaken using the following key words: musculoskeletal disorder, musculoskeletal, injury, dental hygiene, dental hygienist, risk factor, treatment, prevalence, qualitative. Forty-one articles were selected for this review, including systematic reviews, randomized controlled trials, cross-sectional, longitudinal cohort studies, and case studies, using both quantitative and qualitative designs that addressed MSDs and dental professionals. Literature reviews were examined for background information. Excluded were articles not published in English.

DISCUSSION

Signs and symptoms

MSDs may result from repetitive strain or cumulative trauma to muscles, ligaments, tendons, nerves, bones, and joints, resulting in pain, spasms, tingling, numbness, and weakness of the affected regions.[2,8,11] In a study comparing dentists and dental hygienists in British Columbia, it was determined that, within the previous year, 80% of dental hygienists had experienced discomfort in their neck, 75% in the hands, 71% in the shoulders, 64% in the upper back, 59% in the lower back, 45% in the mid-back, and 40% in their arms.[8] Proportions were greater for dental hygienists in all categories when compared to the participating dentists (Figure 1).[8] In another study comparing dental hygienists and dental assistants in Ontario, the dental hygienists had approximately 2 to 3 times greater likelihood of reporting hand, wrist, neck, and shoulder problems in the past year.[22]

Figure 1. Prevalence of MSDs by anatomical region[8]



Risk factors

Despite differences in design, the studies analysed in this review present similar findings. Approximately 92% of dental professionals reported symptoms in at least one anatomical region within one year, with dental hygienists being the group most affected.[1-5,23] Work-related MSDs in dental hygienists are often blamed on repetitive movements, awkward and static postures, pinch-grasp, forceful exertions, vibration, poor ergonomics, and insufficient breaks. Dental hygienists with MSDs tend to work longer hours and treat more clients per day, as

Table 1. Common MSD risk factors, treatment options, and prevention strategies for dental hygienists

Risk factors	Treatment options	Prevention strategies
• Repetitive movements • Awkward/static postures • Lack of task variety • Lack of breaks throughout workday • Cumulative practice hours (10+ years in clinical practice; >34 hours worked per week) • Incorrect position of overhead light • Poorly fitting/ambidextrous gloves • Inadequate support of operator's chair	**Conventional** • Physician • Medications • Splints **Contemporary and alternative** • Acupuncture • Herbal products • Chiropractic/massage therapy • Yoga	• Self-awareness of posture and positioning • Proper position of overhead light and operator/client chairs • Continuing education on MSDs and ergonomics • Regular physical exercise • Preventive massage therapy • Yoga • Surgical magnification telescopes • Use sharpened instruments with handles that are round, lightweight, with large diameter and cross-cut or knurled surface

demonstrated in a Swedish study; researchers reported significant findings for MSDs in dental hygienists who work an average of 34 (± 3.8) clinical hours per week and treat an average of 11 (± 2.7) clients per day.[24] Participants in a qualitative study of American dental hygienists described significant contributing factors for MSDs as lack of control over scheduling clients and selection and procurement of equipment and instruments.[25]

Repetitive movements

Job analysis studies determined not only that instrumentation requires excellent hand-eye coordination and is highly repetitive, but also that dental hygienists often conduct more than 30 strokes per minute, thus increasing their risk for muscle strain.[12,26] Rucker and Sunell reported that dental hygienists in British Columbia spend an average of 21 to 30 units of time (5.25 to 7.5 hours) per day working solely on scaling and root planing procedures, while treating approximately 2 clients per day who are "difficult from an instrumentation perspective."[8, p.45] When instrumenting on clients with heavy calculus deposits, dental hygienists must use additional strength and lateral pressure for controlled function during hand scaling.[1,27] The non-dominant hand often requires great force and static positioning to retract the tongue and cheek during intraoral procedures.[28] Sanders and Michalak-Turcotte claimed that most dental hygienists use small-diameter instrument handles (1/4 inch to 5/16 inch), which along with heavier weight and dull blades contribute to increased pinch-force.[1,12,27,29]

There are contrary findings regarding the use of ultrasonic scalers: 12 out of 41 studies reviewed for this article claim that vibrations contribute to nerve damage and MSDs,[1,6,10,12,13,15,18,23,27-30] while only two suggest ultrasonic scalers as a prevention method to minimize the load from hand-scaling.[1,28] The vibration frequency of ultrasonic scalers, 25,000 Hz to 30,000 Hz, is thought to exceed the threshold for damage to soft tissues, including nerve receptors in the finger tips.[10,12]

Awkward and static postures

Constant repetitive motions combined with awkward and static postures allow muscles, ligaments, and joint capsules to adapt to compromised positions, causing greater pain and significantly increasing dental hygienists' likelihood of developing a debilitating injury.[27] Forty-four percent of British Columbia dental hygienists sit with their legs split on either side of the client's chair, limiting free mobility in the "clock" positions, creating torso twist/tilt, neck flexion, wrist flexion/extension, and shoulder abduction (Figure 2).[8,12] During an hour-long appointment, dental hygienists typically maintain fixed and awkward positions for 30 to 50 minutes, contributing to muscular fatigue and pain created by poor circulation, inefficient removal of lactic acid, and increased muscular pressure.[12] Studies claim that exceeding 15 degrees of neck flexion 75% of the time is harmful; this is especially concerning due to reports of dental hygienists maintaining static postures with approximately 45 degrees of neck flexion.[1,26,31] Additionally, multiple studies of the working postures of dentists found neck flexion greater than 30 degrees 82% of the time and greater than 39 degrees 50% of the time.[31]

Operatory ergonomics and environment

Operatory design and equipment play large roles in either preventing or contributing to work-related MSDs. The following have been named as likely environmental and ergonomic contributors to their development: poor lighting or incorrect position of the overhead light; ability to move freely around the client chair; operator's chair; and gloves.[1,2,8,12,13,27,30]

Figure 2. Demonstrating the dental hygienist's legs split on either side of client's chair

Figure 3. Incorrect overhead light position, creating shadow in oral cavity

Figure 4. Correct overhead light position, light line within 15 degrees of operator's sightline

If the light line is greater than 15 degrees from the operator's sightline, shadows in the oral cavity may result in the dental hygienist sacrificing proper posture to gain a better view (Figures 3 and 4).[20]

The operator's chair should allow the dental hygienist to work in a neutral body position, with elbows and hips bent at approximately 90 degrees. Chairs should provide lumbar support with the seat tapered slightly forward and should be no greater than 25% wider than the buttocks, with a rigid base and 5 casters to prevent tipping.[32]

Ill-fitting intraoral gloves, whether too small, too large or ambidextrous, place increased force and produce a backwards pull on the muscles and ligaments of the operator's hand, creating pain at the base of the thumb and restricting blood flow to the hand.[32]

Lack of job variety

Dental hygienists who work in general clinical practice settings have a defined scope of practice lending itself to an entire workday spent sitting while providing preventive and therapeutic care with little opportunity to stand and stretch.[2,26] Typical appointments often consist of scaling and root planing for 50% to 57% of the time.[12,26,33] Other services, including oral health education, examinations, polishing, desensitizing, fluoride delivery, local anaesthesia, and promoting self-care, are also typically provided by the clinician in a sitting position. Lack of job variety and subsequent opportunity to work using various body positions in the clinical arena create a situation in which the dental hygienist has little alternative but to perform repetitive movements using static postures, exacerbating the risk for MSDs.

Cumulative practice hours

Both age and length of time in clinical practice increase a dental hygienist's risk of experiencing musculoskeletal pain.[8,13,19] In a qualitative study that assessed perceptions of dental hygienists regarding occupation-related health, most participants reported that discomfort frequently occurred, especially after 10 years in practice, and 41% attributed their MSD entirely to clinical tasks.[8,17,25] Risk of injury increases with longer durations spent performing potentially traumatic movements, and throughout the average work day, dental hygienists typically see fewer clients but for longer periods than do dentists.[8,27] In their study, Rucker and Sunell found that 72% of dental hygienists work at least 4 days per week, 95% practise more than 7 hours per day, with the majority treating 8 to 9 clients per day.[8] These results are similar to findings by Sanders and Michalak-Turcotte, and Branson, Black, and Simmer-Beck.[12,26] Sanders and Michalak-Turcotte noted typical 8-hour workdays with a one-hour lunch break and no other scheduled breaks. In addition, dental hygienists who treat more than 11 clients per day report higher rates of pain than those who treat fewer clients, and those who work more than 34 hours per week are at higher risk.[12] Branson et al. reported that a typical work week comprises 31.6 hours, with 29.7 hours spent in client contact.[26]

A study of Swedish dental hygienists revealed a strong correlation between physical workload and hand numbness, likely caused by scaling and root planing instrumentation on several clients per day.[24]

Scheduling, insufficient work breaks, and psychosocial factors

Other commonly noted contributing factors include having little control over client scheduling, lack of breaks throughout the day, and psychosocial issues.[1,12,17,27] Dental hygienists should schedule and determine the length of appointments according to individual client needs, and alternate more periodontally complex clients requiring more aggressive instrumentation with those who have simpler treatment needs.[1]

If, in addition to their lunch hour, dental hygienists have scheduled break periods every morning and afternoon, they may have adequate time to stretch and complete documentation of charts, allowing recovery and therefore counteracting repetitive movements and static postures held throughout the day.[1,34]

Psychosocial contributors, including job demands, time management, and the common drive for perfection, lead to greater stress, which is associated with occupation-related MSDs.[12,25,35,36] Feuerstein, Shaw, Nicholas, and Huang discuss theories surrounding the relationship between perceived stress and upper extremity MSDs, whereby psychosocial stressors lead to physiological responses such as muscle tension and increased release of the stress hormones cortisol and catecholamine.[36]

For some, job demands and time management can cause stress due to production and turnover requirements or to pressure from their employer to fill down-time if the client is late or does not show up.[12,37] Dental hygienists may maximize their allotted time with clients, thus applying greater force, eliminating the potential for breaks, and rushing into the next appointment to continue the cycle.[12] One case study revealed that psychosocial stressors caused the dental hygienist to feel increased tension by the end of each work day.[12] Dental professions tend to attract compulsive individuals who set extremely high performance standards and expectations, which likely contribute to greater mental and physiological stress.[12,35] Finally, psychosocial factors for dental hygienists may be exacerbated by workplace competition and role ambiguity, which stem from the inherent conflict between operating as a self-regulated health care professional while still being predominantly bound to the professional direction of dentists in the clinical private practice setting and driven by an employer-employee relationship.[12,24]

Pain management

To manage pain, many dental hygienists seek conventional solutions (physicians, medications, splints) while others turn to complementary and alternative medicine (CAM) therapies (acupuncture, herbal products, chiropractic/massage therapy, yoga).[8,17,25] Studies reveal that yoga, acupuncture, and massage therapy significantly reduce chronic lower back pain, while massage has short-term, positive effects on chronic neck pain.[8,17]

Chismark, Asher, Curran, Stein, and Tavoc analysed pain management and, when comparing conventional methods to CAM therapies, discovered that dental hygienists who use CAM reported greater overall health (79.3% vs. 54%) along with greater career satisfaction (59.2% vs. 39%). How participants were asked to define overall health was not clear; however, several dental hygienists commented that they would be more inclined to use CAM therapies if such services were covered by health insurance.[23]

Impact of MSDs

Akesson, Johnsson, Rylander, Moritz, and Skerfving cautioned that dental professionals had a significant likelihood of developing symptoms within 5 years, and a greater number left their profession due to MSDs, when compared to clinical nurses.[17] Compared to the one-year prevalence rate of 60% to 96% for dental hygienists, 85.5% of nurses experience work-related MSDs[11] and approximately 60% of clerical workers live with upper-extremity discomfort.[38]

Despite experiencing pain, many dental hygienists continue to work because of financial constraints or because they fear job termination for missed work or filing a worker's compensation claim.[17,25] In order to keep symptoms manageable, numerous dental hygienists choose to work less, decreasing the number of days worked per week, rather than decreasing the hours worked per day.[25] While 27% to 31% reduced their workload, approximately 13% left their jobs for further education, a new profession or retirement.[17,23,25,26] Focus groups revealed that many dental hygienists left the profession early in their careers because they felt ill-prepared for the physical demands of full-time clinical practice.[17,25]

Of the dental hygienists who responded to Rucker and Sunell's survey for the Workers' Compensation Board of BC, 6% lost a total of 30 work days during the previous year due to work-related MSDs, while 2% used vacation time, 5% took unpaid leave, and 2% collected long-term disability benefits.[8]

Unfortunately, the impact of musculoskeletal discomfort and pain does not end with the work day. Research indicates that quality of life is also affected as the dental hygienist's ability to perform routine personal tasks and recreational activities, such as gardening, dressing, and household chores, may be compromised.[8,12]

By the time MSDs are painful enough to affect their work, many dental hygienists feel that their options are limited for changing careers. Participants in a qualitative study of dental hygienists named the following as obstacles to improving work-related MSDs: part-time employment in multiple offices, which makes it difficult to customize equipment and instruments to their individual needs; and the relatively high wage, which tends to outweigh their desire to alleviate symptoms by changing careers.[25]

Not only do MSDs impact the individual, but they have a snowball effect on the entire practice: employers face increased workers' compensation premiums if a claim is submitted, and dental hygiene appointments must be rescheduled, resulting in loss of revenue and dissatisfied clients.[27]

Prevention strategies

Based on the literature reviewed, suggestions for dental hygienists to prevent the development of MSDs include focusing on proper posture and the use of ergonomic instruments and equipment; taking frequent stretch breaks; adjusting operator and client chairs; using magnification telescopes; participating in regular physical exercise; and educating themselves about MSDs. Chismark et al. suggested that dental hygienists who suffer from MSDs find relief when using CAM therapies,[23] so methods such as yoga and massage therapy may also be successful prevention methods.

The least expensive prevention strategies involve awareness and self-evaluation of posture and positioning in relation to the client as well as frequent stretch breaks. Dental hygienists must remain vigilant to minimize the degree of neck and wrist flexion, shoulder abduction, and torso contortion. Dental hygienists must utilize indirect vision via the handheld mirror and proper positioning of the overhead light.[1] For optimal illumination of the oral cavity, the overhead light should be slightly behind the operator's head, thus creating a light line within 15 degrees of the operator's sightline.[20]

The operator chair should allow the dental hygienist to remain in a neutral position, which involves proper lumbar support and keeping the elbows at 90 degrees — ideally supported by bilateral, adjustable arm rests or a trunk support bar set at a height where the knees are even with, or slightly lower than, the dental hygienist's hips.[12]

Another simple and inexpensive solution involves changing one's intraoral gloves.[1,12,27] Ambidextrous gloves ignore the natural arch of the hand and the bulbous "thumb-ball," creating excess pressure and 33% more force on the thumb and fingers.[12,27,39,40] One test analysed the difference between ambidextrous and anatomical (handed) gloves, reporting that the ambidextrous glove immediately pulled the thumb back from its natural position, creating a load of approximately 1.8 pounds on the hand.[38] Intended for short-term use, ambidextrous gloves may lead to muscle fatigue resulting in cumulative trauma if worn for extended periods of time, especially during tasks requiring fine movements.[39,40] Poorly fitting gloves will likely create

a backwards pull on the fingers and thumb, which during grasping motions will increase force on the hand from 0.59 pounds for properly fitting gloves to 2.19 pounds.[39] However, despite these suggestions, one cross-sectional questionnaire found no significant nerve or tissue damage caused by the type, fit or material of ambidextrous gloves.[13]

The work day schedule remains a critical contributor to MSDs, though it is one that, with the employer's understanding and approval, can be rectified. Several studies discuss dental hygienists' lack of control over their daily work schedule as a main issue; however, it appears that control itself would not be a factor if slight adjustments were made. These adjustments include breaks in the morning and afternoon, variable appointment lengths based on individual client need and the dental hygienist's request, and alternating clients who require greater operator force and time for removal of tenacious deposits with those who require less.[1,12,27]

One research team advised a minimum of 6 minutes of rest per hour of work that involves repetitive movements.[34] The same study discussed the most effective type of breaks for dentists, which, given the nature of the work, would also apply to dental hygienists. These breaks involve: 1) relaxing, dropping, and shaking one's arms for approximately 15 seconds; 2) performing movements opposite to those involved in the static and repetitive tasks; and 3) periods of rest for 10 to 15 minutes every 2 to 3 hours.[34]

The weight and diameter of instrument handles should be chosen by and appropriately suited to each dental hygienist. Light-weight handles with a large diameter (wider than 11 mm) and a surface that is either cross-cut or knurled will decrease the need for pinch-grip and forceful exertions.[12,29,32] Although multiple studies stressed the need for sharp blades to prevent discomfort,[1,12,29,32] one study claimed that 74% of dental hygienists sharpen their instruments only when they become obviously dull.[12] Curettes should be sharpened before each client to ensure efficient and safe removal of deposits.[12]

Surgical magnification telescopes (SMTs) or scopes/loupes have been suggested by many researchers as an effective preventive and corrective tool.[8,12,15,20,26,41] The use of correctly aligned SMTs reduces pinch-force, torso contortion, and neck flexion, therefore reducing strain which significantly decreases lower back, upper back, and neck pain.[7,8,12,15,41] According to a qualitative study of American dental hygienists, only 59.7% of 868 respondents use SMTs while working in a clinical setting.[41]

Several studies noted that dental hygiene entry-to-practice programs should include a lengthy course devoted to ergonomic training, long-term benefits of regular physical exercise, and use of CAM therapies in order to prevent the development of MSDs.[1,12,16,23]

Critique of research

The studies discussed in this review contribute to a better understanding of occupation-related MSDs in dental hygienists through cross-sectional and longitudinal designs, using qualitative, quantitative, and mixed method approaches. Specific data collection methods involved pilot tests, questionnaires, interviews, focus groups, case studies, participant journals, and physical exams.

Strengths

Pilot studies, used to test interview guides, and triangulation of data collection methods within the qualitative studies helped to increase the trustworthiness of the findings.[37,44] In 2 of the qualitative studies, an iterative approach was used during focus groups and semi-structured interviews during which participants answered open-ended questions.[25,35] This method allowed researchers to gain new insight that may not have been discovered had they used closed-format questions.[42] Although not transcribed verbatim, data were captured during each session via audio recordings which, along with written notes taken by multiple moderators, were independently reviewed by at least 2 investigators.

Within the quantitative studies, longitudinal designs and the statistical analyses of large samples from various geographic regions improved generalizability.[42,43] The majority of dental hygiene participants were sampled from national or regional associations which is likely a representative sample of the dental hygienist population in general.[23]

Limitations

Despite these strengths, some limitations exist. First, self-reporting questionnaires may have resulted in respondent bias due to the potential challenge of recalling past events. Second, researchers must remain sensitive to the potential for groupthink in focus groups where participants may refrain from voicing an opinion if it does not align with the vocalized consensus of their peers.[42] Third, there was an apparent lack of member-checking which, if used, involves the participants in verification of the findings, and reduces the potential for researcher bias.[44,45]

The greatest limitation of the quantitative studies is that, while cross-sectional studies provide useful information on prevalence rates, they do not allow for causal relationships to be determined.[2,46,47] Nonetheless, many studies concluded that the risk factors outlined are strongly associated with MSDs. Therefore, it is likely that future longitudinal studies would strengthen causality.

Research gaps and future recommendations

Several studies have been conducted to determine the etiological and contributing factors for MSDs in dental professionals; however, further research is required to determine whether occupation-related damage can be prevented entirely. Future qualitative studies could explore the opinions of dental hygienists and policy makers regarding insurance coverage through their professional associations, which might help to manage the costs of preventive CAM therapies. In addition, qualitative studies could provide a deeper understanding of perceptions of practice owners about making necessary ergonomic and scheduling improvements to prevent MSDs.

Missing from the current literature are studies analysing the prolonged use and subsequent impact of SMTs and ultrasonic scalers on the development of MSDs. While ultrasonic scalers are designed to reduce operator strain, current studies present contradictory and inconclusive evidence regarding their relationship to musculoskeletal fatigue and pain. More studies are needed to determine the prevalence of MSDs among those using SMTs regularly in clinical practice, as well as the prevalence of dental professionals using correctly aligned SMTs. Future randomized controlled trials should assess the long-term consequences of repeated use of SMTs and ultrasonic scalers, as well as the ideal weight and diameter of scaling instruments.

It may also be valuable to investigate 1) the effects of recreational activities, in addition to work-related factors, on the development of MSDs; 2) to what extent productivity in the workplace is affected by employing a clinician who has MSDs; and 3) models that involve extended or alternative health insurance combined with disability insurance for all members of a dental hygiene association.

CONCLUSION

MSDs, such as carpal tunnel syndrome, trapezius myalgia, tension neck syndrome, and median neuropathy, can have a significant impact on dental hygienists who work in clinical practice. Pain and discomfort tend to develop in the wrist, hand, neck, shoulders, and back with risk factors ranging from cumulative and repetitive strain to ill-fitting gloves. Once pain is noticed, dental hygienists often turn to conventional and/or alternative treatments and therapies. Without in-depth knowledge of musculoskeletal health and injuries, as well as preventive and coping methods, dental hygienists may be forced to endure daily pain while continuing to work. If the injury is allowed to progress, some dental hygienists may have no option but to leave clinical practice.

Preventive strategies are critical for dental hygienists to maintain their musculoskeletal health and enjoy longevity in clinical practice. Dental hygienists must continuously assess their posture, instruments, and equipment, including gloves and SMTs, as well as the design of their operatory. They must listen to their body and take action if they begin to feel discomfort while fulfilling their clinical responsibilities. Taking frequent stretch breaks throughout the work day, making time for regular physical exercise, and using preventive CAM therapies early in one's career may help to minimize the potential for injury, which is so common to those in the dental hygiene profession.

Dental hygiene students expend significant finances and resources on their education to prepare for a healthy and lengthy career as a dental hygienist. Yet, many practising dental hygienists do not seem to adopt preventive and maintenance strategies outlined in this review. Dental professionals need to place a higher value on their long-term health and recognize the potential financial losses and dissatisfaction that they are likely to experience if they do not invest in preventive care.

REFERENCES

1. Michalak-Turcotte C. Controlling dental hygiene work-related musculoskeletal disorders: the ergonomic process. *J Dent Hyg.* 2000;74:41–48.
2. Hayes MJ, Smith DR, Cockrell D. An international review of musculoskeletal disorders in the dental hygiene profession. *Int Dent J.* 2010;60:343–52.
3. Morse T, Bruneau H, Michalak-Turcotte C, et al. Musculoskeletal disorders of the neck and shoulder in dental hygienists and dental hygiene students. *J Dent Hyg.* 2007;81:1–16.
4. Ylipaa V, Szuster F, Spencer J, Preber H, Benko SS, Arnetz BB. Health, mental well-being, and musculoskeletal disorders: a comparison between Swedish and Australian dental hygienists. *J Dent Hyg.* 2002;76:47–58.
5. Morse T, Bruneau H, Dussetschleger J. Musculoskeletal disorders of the neck and shoulder in the dental professions. *Work.* 2010;35(4):419–29.
6. Lalumandier J, McPhee S. Prevalence and risk factors of hand problems and Carpal Tunnel Syndrome among dental hygienists. *J Dent Hyg.* 2001;75:130–34.
7. Hayes MJ, Taylor JA, Smith DR. Predictors of work-related musculoskeletal disorders among dental hygienists. *Int J Dent Hyg.* 2012 Nov;10(4):265–69.
8. Rucker LM, Sunell S. Musculoskeletal health status in BC dentists and dental hygienists: Evaluating the preventive impact of surgical ergonomics training and surgical magnification. Vancouver: Workers' Compensation Board of British Columbia; 2000. pp. 1–91.
9. Hayes MJ, Smith DR, Taylor JA. Musculoskeletal disorders in a 3-year longitudinal cohort of dental hygiene students. *J Dent Hyg.* 2014;88:36–41.
10. Warren N. Causes of musculoskeletal disorders in dental hygienists and dental hygiene students: A study of combined biomechanics and psychosocial risk factors. *Work.* 2010;35(4):441–54.
11. Hayes MJ, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. *Int J Dent Hyg.* 2009;7:159–65.
12. Sanders MA, Michalak-Turcotte C. Strategies to reduce work-related musculoskeletal disorders in dental hygienists: two case

studies. *J Hand Ther*. 2002;15(4):363–74.

13. Werner RA, Hamann C, Franzblau A, Rodgers PA. Prevalence of carpal tunnel syndrome and upper extremity tendinitis among dental hygienists. *J Dent Hyg*. 2002;76(2):126–32.
14. Smith CA, Sommerich CM, Mirka GA, George MC. An investigation of ergonomic interventions in dental hygiene work. *Appl Ergon.* 2002;33(2):175–84.
15. Hayes MJ, Osmotherly PG, Taylor JA, Smith DR, Ho A. The effect of wearing loupes on upper extremity musculoskeletal disorders among dental hygienists. *Int J Dent Hyg*. 2014;12(3):174–79.
16. Gupta D, Bhaskar DJ, Gupta RJ, Jain A, Yadav P, Dalai DR, Singh R, Singh N, Chaudhary V, Singh A, Yadav A, Karim B. Is complementary and alternative medicine effective in job satisfaction among dentists with musculoskeletal disorders? A cross sectional study. *Med Pr*. 2014;65(3):317–23.
17. Akesson I, Johnsson B, Rylander L, Moritz U, Skerfving S. Musculoskeletal disorders among female dental personnel — clinical examination and a 5-year follow-up study of symptoms. *Int Arch Occup Environ Health*. 1999;72:395–403.
18. Akesson I, Lundborg G, Horstmann V, Skerfving S. Neuropathy in female dental personnel exposed to high frequency vibrations. *Occup Environ Med*. 1995;52:116–23.
19. Brockmann W. Musculoskeletal disorders in dental hygienists. *Dent Abstr.* 2011;56(4):192–95.
20. Sunell S, Rucker L. Surgical magnification in dental hygiene practice. *Int J Dent Hyg*. 2004;2:26–35.
21. Green BN, Johnson CD, Adams A. Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *J Chiropr Med.* 2006;5(3):101–17.
22. Liss G, Jesin E, Kusiak R, White P. Musculoskeletal problems among Ontario dental hygienists [Abstract]. *Am J Ind Med.* 1995;28(4):521.
23. Chismark A, Asher G, Curran A, Stein M, Tavoc T. Use of complementary and alternative medicine for work-related pain correlates with career satisfaction among dental hygienists. J *Dent Hyg.* 2011;85(4):273–84.
24. Petren V, Petzall K, Preber H, Bergstrom J. The relationship between working conditions and sick leave in Swedish dental hygienists. *Int J Dent Hyg.* 2007;5:27–35.
25. Crawford L, Gutierrez G, Harber P. Work environment and occupational health of dental hygienists: A qualitative assessment. *J Occup Environ Med.* 2005;47(6):623–32.
26. Branson BG, Black MA, Simmer-Beck M. Changes in posture: A case study of a dental hygienist's use of magnification loupes. *Work.* 2010;35(4):467–76.
27. Kerschbaum WE, Liskiewicz T. Cumulative trauma disorders: an ergonomic approach for prevention. *J Dent Hyg*. 1997;71(4):162–67.
28. Akesson I, Balogh I, Hansson GA. Physical workload in neck, shoulders and wrists/hands in dental hygienists during a work-day. *Appl Ergon.* 2012;43(4):803–11.
29. Rempel D, Lee DL, Dawson K, Loomer P. The effects of periodontal curette handle weight and diameter on arm pain A four-month randomized controlled trial. *J Am Dent Assoc*. 2012 Oct;143(19):1105–13.
30. Rucker LM, Sunell S. Ergonomic risk factors associated with clinical dentistry. *J Calif Dent Assoc.* 2002; 30(2):139–48.
31. Finsen L, Christensen H, Bakke M. Musculoskeletal disorders among dentists and variation in dental work. *Appl Ergon*. 1998; 29:119–25.
32. Occupational Health Clinics for Ontario Workers Inc. Ergonomics and dental work. Ontario: Occupational Health Clinics for Ontario Workers Inc. [Internet]; 2012 [cited 2015 May 11]. Available from: http://www.ohcow.on.ca/uploads/Resource/Workbooks/ERGONOMICS%20AND%20DENTAL%20WORK.pdf
33. Yee T, Crawford L, Harber P. Work environment of dental hygienists. *J Exp Med.* 2005;47(6):633–39.
34. Harutunian K, Gargallo-Albiol J, Figueiredo R, Gay-Escoda C. Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the school of dentistry of the university of Barcelona (Spain). A cross-sectional study. *Med Oral Patol Oral Cir Bucal.* 2011;16(3):425–29.
35. Hill KB, Burke FJT, Brown J, Macdonald EB, Morris AJ, White DA, Murray K. Dental practitioners and ill health retirement: a qualitative investigation into the causes and effects. *Br Dent J.* 2010;209(5):1–8.
36. Feuerstein M, Shaw WS, Nicholas RA, Huang GD. From confounders to suspected risk factors: psychosocial factors and work-related upper extremity disorders. *J Electromyogr Kinesiol.* 2004;14:171–78.
37. Ylipaa V, Arnetz BB, Preber H. Factors that affect health and well-being in dental hygienists: a comparison of Swedish dental practices. *J Dent Hyg*. 1999;74:191–99.
38. Feng B, Liang Q, Wang Y, Andersen L, Szeto G. Prevalence of work-related musculoskeletal symptoms of the neck and upper extremity among dentists in China. *Brit Med J*. 2014;4(12):1–8.
39. Zedalis MS, Bennett B. Ambi gloves: deal or no deal? Short-term convenience; long-term threat of CTD. *Chilton's Industrial Safety and Hygiene News.* 2011;45(2):30–32.
40. Powell BJ, Winkley GP, Brown JO, Etersque S. Evaluating the fit of ambidextrous and fitted gloves: implications for hand discomfort [Abstract]. *J Am Dent Assoc*. 1994;125(9):1235–42.
41. Thomas J, Thomas FD. Dental hygienists' opinions about loupes in educations. *J Dent Hyg*. 2007;81(4):1–12.
42. Gill P, Stewart K, Treasure E, Chadwick B. Methods of data collection in qualitative research: interviews and focus groups. *Br Dent J*. 2008;204(6):291–95.
43. Cohen DJ, Crabtree BF. Evaluative criteria for qualitative research in health care: controversies and recommendations. *Ann Fam Med.* 2008;6(4):331–39.
44. Kanji Z. Decoding qualitative research for dental hygiene. *Can J Dent Hyg.* 2012;46(4);239–43.
45. Burnard P, Gill P, Stewart K, Treasure E, Chadwick B. Analysing and presenting qualitative data. *Br Dent J*. 2008;204(8):429–32.
46. Oleckno WA. Essential epidemiology principles and applications. Prospect Heights, Illinois: Waveland Press; 2002.
47. Anton D, Rosecrance J, Merlino L, Cook T. Prevalence of musculoskeletal symptoms and carpal tunnel syndrome among dental hygienists. *Am J Ind Med.* 2002;42:248–57.

Experience the Philips Zoom difference

Call for your free trial today

Why dental professionals prefer Philips Zoom:

- No.1 in-office whitening treatment*
- Clinically proven superior results
- Unmatched practice-building resources

Exactly what you'd expect from the No.1 patient-requested professional whitening brand*

innovation + you

Philips Zoom
WhiteSpeed

Philips Zoom
QuickPro

Philips Zoom
Whitening Pen

Philips Zoom
DayWhite Gentle

№1 in-office Whitening treatment*

For more information, call **(800) 278-8282**
or visit **philipsoralhealthcare.com**

*In the U.S.

PHILIPS
ZOOM!

Ultimate clean.
Superior results.

Philips Sonicare DiamondClean
It's the jewel of our collection for a good reason.

- Eliminates surface stains for whiter smiles in just one week[1]
- 7x better plaque removal[2]
- Improved gingival health in two weeks

innovation you

Call **(800) 278-8282** or visit **philips.ca** to order yours

1 Data on file, 2010
2 Than a manual toothbrush, Delaurenti M, et al. An Evaluation of Two Toothbrushes on Plaque and Gingivitis. Journal of Dental Research. 2012, 91 (Special Issue B):522.

PHILIPS
sonicare

NEW

SUNSTAR

G·U·M®

SOFT-PICKS® ADVANCED

EASY, EFFECTIVE, COMPLETE

CUTTING EDGE DESIGN

- Improved grip for comfort and control, adapted to the dental arches.
- To easily reach any area of the mouth, including difficult to access posterior surfaces.

SOFT BRISTLES

- One time use, disposable.
- To effectively clean between teeth and micro massage gums for healthy and firm gums.

TAPERED DESIGN

- To enhance adaptability to both smaller and wider spaces.
- To easily use with orthodontics, implants and bridges.

TISSUE FRIENDLY

- Soft rubber bristles.

PATIENT FRIENDLY

- Increases patient compliance for daily interdental cleaning.
- Not made with natural rubber latex.
- Wood and metal free.

To order or for more information:

1-800-265-8353

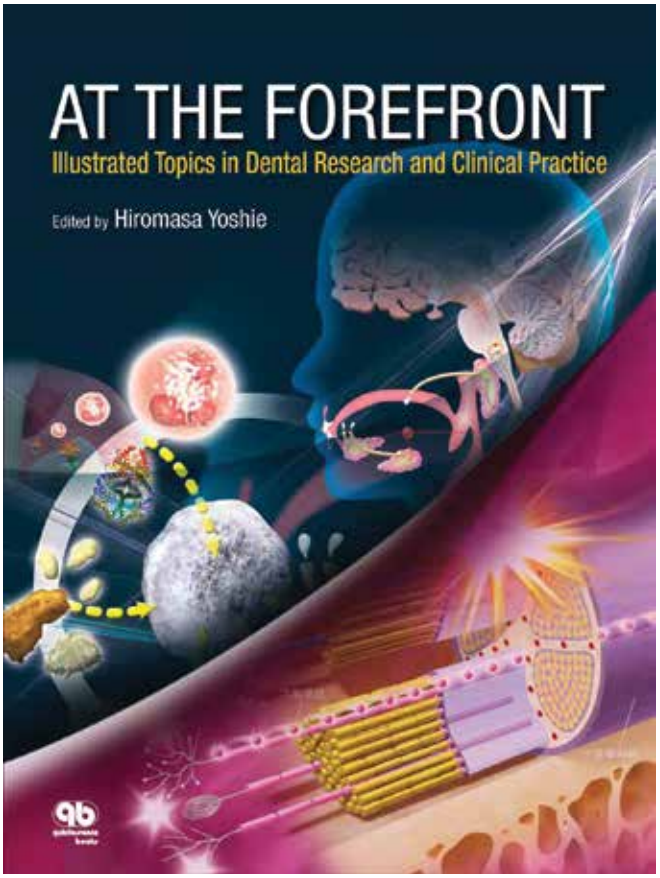
www.GUMbrand.ca

can.customerrelations@ca.sunstar.com

C16074

At the forefront: Illustrated topics in dental research and clinical practice

Edited by Hiromasa Yoshie
Chicago: Quintessence Publishing Inc.; 2012. 108 pp. (softcover)
ISBN 978-0-86715-515-0 (B5150); available from Quintessence Publishing (www.quintpub.com)



This book presents a collection of articles on topics such as bioscience and clinical science, interspersed with a striking display of vibrant three-dimensional illustrations. The chapters represent a collaborative effort of various authors in their fields of expertise, all of whom are researchers or clinicians from Japanese universities or dental schools. The editor of the book, Hiromasa Yoshie, is professor and chair of the Division of Periodontology, Department of Oral Biological Sciences, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan, and a well-respected author of more than 208 publications. As the title suggests, this book highlights novel technologies in dentistry and is recommended to students, clinicians, and researchers. The editor has accomplished the goal of stimulating the readers' curiosity thanks to the book's captivating bold-typed title and the use of exceptional illustrations.

The purpose of this book is to increase the awareness of periodontal medicine and regenerative technologies and their potential for application in dental science, with contributions to future paradigm shifts in the approach to many clinical procedures. The chapters are brief and concise, providing a good introduction to several concepts. While the intended audience is dentists, oral surgeons, and researchers, this book is beneficial to all dental professionals because it encourages further exploration of these important subjects.

SUMMARY OF CONTENT

The book is well organized, highlighting key factors in the discussion of current and future leading-edge dental science and clinical technology. The table of contents allows for easy navigation to the appropriate chapters and is conveniently divided into two distinct parts. The first part is designed to introduce advanced periodontology and tissue engineering; the second part focuses on emerging clinical science in operative dentistry. Each part has twelve chapters on differing topics that are connected to the previous subject, thus gradually and appropriately introducing the readers to the information and sparking their curiosity in the process.

In the first half of the book, genotyping, identification of patients' susceptibility to periodontal disease, and identification of periodontitis-related genes are discussed. A diagnostic system is explored for periodontitis that includes blood and salivary testing for periodontal diagnosis. Also incorporated are periodontal tissue, salivary gland, and tooth regenerative procedures as well as tissue-engineered bone techniques. This first half concludes with a discussion of the correlation between periodontal disease and cardiovascular disease; preterm low birth weight; diabetes; and the genetic diagnosis of drug-induced gingival overgrowth.

The second half of the book focuses on clinical issues such as dentinal remineralization and hypersensitivity, effects of dental whitening on the tooth surface, carious

dentin removal prior to restorations using a caries detector, nerve injury due to extractions or implant placement, morphological changes within the mandibular canal after tooth loss, as well as identification of vessels and nerves within the maxillary tuberosity region for implant placement.

ANALYSIS AND EVALUATION

The layout and visual appeal of the book are very pleasing. Not only is the front cover colourful but, throughout the book's 108 pages, there are 188 colour illustrations. The accurate anatomical pictures in the last few chapters on nerve injury, curable versus incurable; changes in the mandibular canal morphology after tooth loss; and morphological changes in the maxillary sinus in the edentulous maxilla provide an excellent review for dental hygienists in oral anatomy. The writing style is clear and concise, with the illustrations helping to clarify the information. The topics presented stimulate interesting discussion for clinicians and their clients.

The content of the book seems reasonably comprehensive although not informative enough to formulate evidence-based conclusions. The references or recommended reading materials are limited, making the investigation of the presented information somewhat incomplete. Additionally, the chapters are written from the perspective of dentists and researchers from the Japanese Society of Periodontology (JSP), which may not reflect the views and expertise of other clinicians globally. Some of the information is new and based on the novelty of anticipation rather than on systematic or meta-analysis evidence. An omission from the list of contents and chapter objectives is a discussion of the treatment and care of periodontal disease, which would have complemented the exploration of genetic predisposition and diagnosis as well as periodontal tissue regeneration. Many new advancements have been made in this field lately, such as the use of lasers for calculus deposit detection and removal, and antimicrobial therapy. This material would be a very important chapter to add to the list of topics at the forefront of dental research and clinical practice.

The authors have done a good job in presenting a collection of innovative and creative topics. These subjects spark interest in and discussion of the future paths evolving in the field of dentistry. Especially interesting are the developments in tooth regenerative therapies along with salivary and blood diagnostics for periodontal disease. The authors claim the ultimate goal is the development of a fully functioning bioengineered tooth that can replace a lost or damaged organ after injury, disease or aging. While the future of regenerative therapy and diagnostics appears promising, it nevertheless needs to be further studied and benchmarked using existing gold standards for assessment of disease, such as clinical attachment and alveolar bone support.

Not all chapters are supported by references (e.g., chapters 20, 21, 22, and 24). Additionally, the references used to support the information in chapter 18 are dated and may not be current enough to support the claims made regarding advancements in restorative material technology. These references date back to 1981, with 1989 being the most current in this chapter. The oldest reference goes as far back as 1972 in chapter 13 on the topic of "Dentin Hypersensitivity." A lack of references is also evident in Chapter 3, which discusses analysis of saliva for periodontal diagnosis and monitoring. Only two references are used to support this information, one of which is over ten years old. Overall, the references for each chapter are not as current as one would expect given that the topics are on current and advanced technology.

Strengths of the book

The chapter topics tend to follow logically from one to the next, which allows for the information to be slowly introduced without overwhelming the reader with details. Each chapter remains focused on its subject thanks to a consistently clear and straightforward presentation of the information by the authors.

The book presents a compilation of enlightening and progressive chapters on technology reinforced with instructively colourful illustrations. Regenerative therapy, genotyping, and tissue engineering are important and innovative topics that are appropriately represented in the book.

Not only does the book present novel ideas for the future, but it also dedicates a few chapters to current important topics that are at the forefront of research. More specifically, these include the relationship between periodontal disease and numerous systemic conditions such as cardiovascular disease, adverse pregnancy outcomes, and diabetes.

The illustrations are very helpful in explaining the information presented throughout the book. This is especially evident in the latter chapters that discuss nerves and vessels of the maxillary tuberosity region. The illustrations provide an excellent review and visual examination of the head and neck anatomy for the dental hygienist, and show why it is essential to take extra care when administering anesthesia in the posterior part of the maxilla. The posterior superior alveolar (PSA) nerve first travels on the external surface of the bone, prior to entry into the bone, and the target injection site is located in a highly vascularized area, thus increasing the risk for hematoma and creating a challenge with both hemostasis and the administration of anesthesia for this regional nerve block.

Weaknesses of the book

The book has a couple of weaknesses. First, shortly after opening the book and scanning its wonderful and colourful pages, the cover came apart, creating a disappointing start to the review. Second, a recurring theme was a lack of supportive references and limited autobiographies of the authors of each chapter. Having more information on the authors and the editor would provide the reader with a greater appreciation for their expertise in relation to the topics discussed. Additionally, studies based on higher levels of clinical evidence, such as systematic reviews or meta-analyses, would assist the reader in making evidence-based decisions.

CONCLUSION

Overall, I would recommend this book for both dental hygiene students and practising dental hygienists either as an introduction to emerging developments in dentistry or as a review of important points in clinical research and clinical practice. This book succeeds in increasing awareness of bioscience and clinical science. It is an excellent source of illustrations that stimulate curiosity and further investigation.

Further study of the chapter topics through an exploration of other more current published resources is encouraged. Given that the authors are clinicians and researchers from Japan, as are many of the cited studies, further exploration of the literature would also allow readers to gain a broader, more global understanding of the subject matter. Although it contains minimal dental hygiene-specific content, the book is thought provoking for all health professionals. In general, this book is not meant as a stand-alone resource but rather as an introductory guide to salient and emerging topics. As stated by the editor of the book, each chapter touches on specific matters in dental research and is useful as an introduction. With this understanding of its limitations, this book could be a valuable, informative guide to further literature review.

Karen Gallagher, BDSc, RDH, is a dental hygienist currently on sabbatical for further education.

TD Insurance
Meloche Monnex

Get more out of your CDHA membership.

Get **preferred insurance rates** today!

Take advantage of your group privileges:

You could **save $415*** or more when you combine your home and auto insurance with us.

Because you've earned it.

At TD Insurance we believe your efforts should be recognized. That's why, as a **Canadian Dental Hygienists Association** member, you have access to the TD Insurance Meloche Monnex program, which offers you preferred insurance rates and highly personalized service, along with additional discounts. **Request a quote and find out how much you could save!**

Our extended business hours make it easy.
Monday to Friday: 8 a.m. to 8 p.m. (ET)
Saturday: 9 a.m. to 4 p.m. (ET)

Home and auto insurance program recommended by

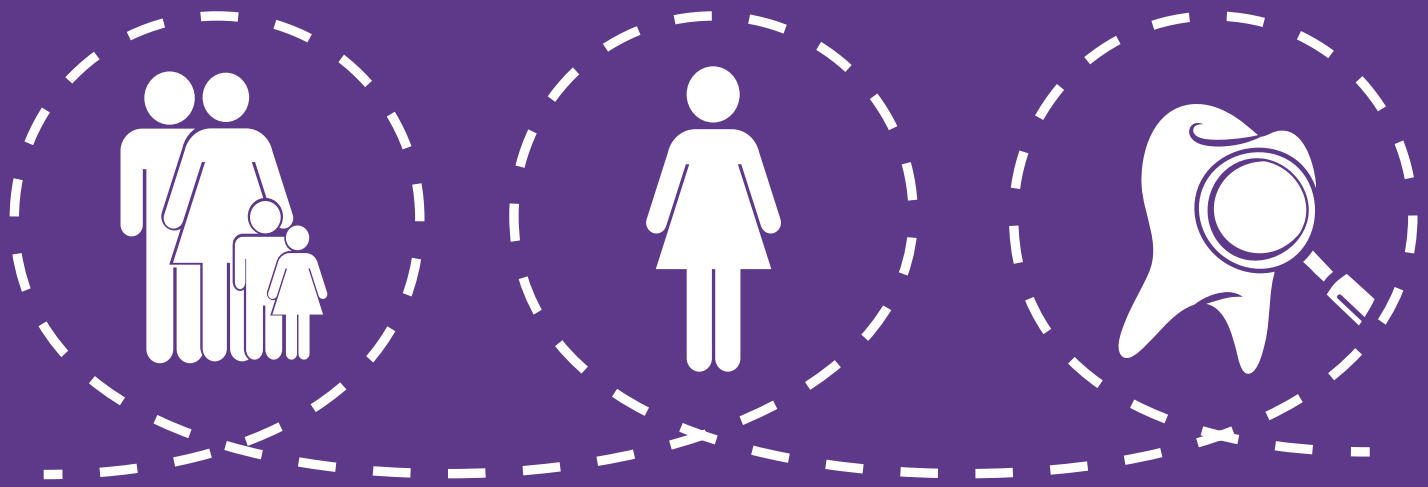
THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

HOME | AUTO

Ask for your quote today at 1-866-269-1371
or visit melochemonnex.com/cdha

Get the benefits of group coverage

tailored to your individual needs



Not all CDHA members are alike.

You may be married with children, on your own, or running a practice. But there is one thing all members have in common – financial responsibility. **CDHA's Insurance Program helps you protect yourself, and your family, business and assets against life's uncertainties.**

CDHA Insurance Plan advantages:

- Insurance designed specifically for CDHA members
- Affordable group prices
- Flexible, comprehensive coverage

Learn more by visiting **www.sunlife.ca/cdha**.

CDHA ACHD
THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

Sun Life Financial

THEIR DENTURES SHOULDN'T BE ONE OF THEM.[1-5]

Though your patients may take comfort in keeping their dentures in at night, the consequences can be severe, from increased odour to fungal infections to increased caries.[1-5] Guiding your patients through the best nighttime routine could be one of the most important conversations you have with them. That means removal and gentle, antibacterial cleaning with Polident®.[6]

1. Jeganathan S, Payne JA, Thean HP. Denture stomatitis in an elderly edentulous Asian population. *J Oral Rehabil*. 1997;24(6):468–472. **2**. Emami E, de Grandmont P, Rompré PH, et al. Favoring trauma as an etiological factor in denture stomatitis. *J Dent Res*.2008;87(5):440–444. **3**. Barbeau J, Seguin J, Goulet JP, et al. Reassessing the presence of *Candida albicans* in denture-related stomatitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2003;95(1):51–59. **4**. Arendorf TM, Walker DM. Oral candida populations in health and disease. *Br Dent J*. 1979;147(10):267–272. **5**. Compagnoni Ma, Souza RF, Marra J, et al. Relationship between Candida and nocturnal denture wear: quantitative study. *J Oral Rehabil*. 2007;34(8):600–605. **6**. GSK data on file, 2011. (Polident CSS)

Guidelines for authors

The *Canadian Journal of Dental Hygiene* (CJDH) is a triannual peer-reviewed publication of the Canadian Dental Hygienists Association. It invites manuscript submissions in English and French on topics relevant to dental hygiene practice, theory, education, and policy. Manuscripts should deal with current issues, make a significant contribution to the body of knowledge of dental hygiene, and advance the scientific basis of practice. All pre-submission enquiries and submissions should be directed to journal@cdha.ca

Manuscript categories

1. **Original research articles:** maximum 6000 words, no more than 150 references, and an abstract within 250 words.
2. **Literature reviews:** between 3000 and 4000 words, no more than 150 references, and an abstract within 250 words.
3. **Short communications/Case reports:** maximum 2000 words, as many references as required, and an abstract within 150 words.
4. **Position papers:** maximum 4000 words, no more than 100 references, and an abstract within 250 words. This category includes position papers developed by CDHA.
5. **Letters to the editor:** maximum 500 words, no more than 5 references and 3 authors. No abstract.
6. **Editorials:** by invitation only.

Our "Manuscript Preparation Tips" offer details on the required components of each manuscript category and are available at www.cdha.ca/cjdh.

Manuscript topics

CJDH welcomes your original submissions on

- *Professionalism:* ethics, social responsibility, legal issues, entrepreneurship, business aspects, continuing competence, quality assurance, and other topics within the general parameters of professional practice.
- *Clinical practice:* interceptive, therapeutic, preventive, and ongoing care procedures to support oral health.
- *Oral health sciences:* knowledge related to the sciences that underpin dental hygiene practice.
- *Theory:* dental hygiene concepts or processes.
- *Health promotion:* public policy and elements integral to building the capacity of individuals, groups, and society at large, such as the creation of supportive learning environments, developing abilities, strengthening community action, and reorienting oral health services.
- *Education and evaluation:* teaching and learning at an individual, group or community level (includes education related to clients, oral health professionals, as well as program assessment, planning, implementation and evaluation).

Please note that manuscripts submitted to CJDH should be the original work of the author(s) and should not be under review or previously published by another body in any written or electronic form. This does not include abstracts prepared for and presented at a scientific meeting and subsequently published in the proceedings. The journal's full Ethics Policy governing authorship, conflict of interest, research ethics, and academic misconduct is available online at www.cdha.ca/cjdh. Please consult this document prior to submitting your manuscript.

Peer review: All papers undergo initial screening by the Scientific Editor to ensure that they fall within the journal's mandate and meet our submission requirements. Suitable papers are then sent for peer review by two or more referees. This process also applies to position papers generated by CDHA, given that they involve an analysis of literature. Additional specialist advice (e.g., from a statistician) may be sought for peer review if necessary.

Revision: When a manuscript is returned to the corresponding author for revision, the revised version should be submitted within 6 weeks of the author's receipt of the reviewer reports. The author(s) should explain in a detailed covering letter how the requested revisions were addressed or why they were discounted. If a revised manuscript is resubmitted after the 6-week period, it may be considered as a new submission. Additional time for revision may be granted upon request, at the scientific editor's discretion.

Manuscript submission checklist

Check	Cover Letter
	Originality of the work and any conflicts of interest declared
	Contact information for corresponding author provided
Check	**Manuscript**
	Text is presented in a clear font, such as Arial or Times New Roman, double-spaced, and in 12-point size.
	All margins are 1 inch (2.5 cm).
	Pages are numbered consecutively, starting with title page.
	Authors' full names, academic degrees, and affiliations are listed on the title page.
	Corresponding author's contact information is provided on the title page.
	Key words from the Medical Subject Headings (MeSH) database at www.nlm.nih.gov/mesh/meshhome.html are listed after the abstract.
	Abbreviations and units conform to the *Système international d'unités* (SI). SI symbols may be used without definition in the body of the paper. Abbreviations are defined in parentheses after their first mention in the text.
	Figures and tables are numbered consecutively, cited in the text, and inserted at the end of the manuscript.

Check	Manuscript
	Previously published tables or figures are accompanied by written consent from the copyright holder (usually the publisher) to reproduce the material in the print and online versions of CJDH.
	Any information (text or images) identifying clients or research subjects is accompanied by written consent from the individual(s) to publish the information in CJDH.
	References in the text are numbered and listed in order of appearance.
	References are formatted according to the Vancouver style (www.nlm.nih.gov/bsd/uniform_requirements.html), using abbreviated journal titles.
	Personal communications are not included in the reference list but are cited in parentheses in the text. Confirmation of permission to print the quotation is included in the Acknowledgements section.

Artwork includes any illustrations, graphs, figures, photographs, and any other graphics that clearly support and enhance the text. This artwork must be supplied in its original file format (as source files). Acceptable file formats include .eps, .pdf, .tif, .jpg, .ai, .cdr in high resolution, suited for print reproduction:

- minimum of 300 dpi for grayscale or colour halftones
- 600 dpi for line art
- 1000 dpi minimum for bitmap (b/w) artwork
- colour artwork submitted in CMYK (not RGB) colour mode

The author(s) must provide proof of permission to reproduce previously produced artwork from the original source and acknowledge the source in the caption. The editorial office reserves the right to reschedule publication of an accepted manuscript should there be delays in obtaining permissions or artwork of suitable print quality.

Data or tables may be submitted in Excel or Word formats.

Supplementary information

Supplementary information is peer-reviewed material directly relevant to the conclusions of an article that cannot be included in the printed version owing to space or format constraints. It is posted on the journal's web site and linked to the article when the article is published and may consist of additional text, figures, video, extensive tables or appendices. Sources of supplementary information should be acknowledged in the text, and permission for using them sent to the editorial office at the time of submission. All supplementary information should be in its final format because it will not be copy-edited and will appear online as originally submitted.

SAMPLES OF REFERENCES AND CITATIONS

CJDH, like most biomedical and scientific journals, uses the Vancouver citation style for references, which was established by the International Committee of Medical Journal Editors in 1978. References should be numbered consecutively in the order in which they are first mentioned in the text. Use the previously assigned number for subsequent references to a citation (i.e., no "op cit" or "ibid"). Use superscript Arabic numerals to identify the reference within the text (e.g.,[1,2] or [3–6]). For more information on this style and the uniform requirements for manuscript preparation and submission, please visit www.nlm.nih.gov/bsd/uniform_requirements.html. Examples of how to cite some common research resources appear below.

JOURNAL ARTICLES

Standard article

Orban B, Manella VB. A macroscopic and microscopic study of instruments designed for root planing. *J Periodontol.* 1956;27:120–35.

Volume with supplement

Orban B, Manella VB. A macroscopic and microscopic study of instruments designed for root planing. *J Periodontol.* 1956;27 Suppl 7:S6–12.

Conference proceedings – abstract

Austin C, Hamilton JC, Austin TL. Factors affecting the efficacy of air abrasion [abstract]. *J Dent Res.* 2001;80(Special issue):37.

No author

What is your role in the profession? [editorial] *J Dent Topics.* 1999;43:16–17.

Organization as author

Canadian Dental Hygienists Association. Policy framework for dental hygiene education in Canada. *Probe.* 1998;32(3):105–7.

BOOKS AND OTHER MONOGRAPHS

Personal authors

Hooyman NR, Kiyak HA. *Social gerontology: A multidisciplinary perspective.* 6th ed. Boston: Allyn & Bacon; 2002.

Editors as authors

Cairns J Jr, Niederlehner BR, Orvosm DR, editors. *Predicting ecosystem risk.* Princeton (NJ): Princeton Scientific Publications; 1992.

Chapter in book

Weinstein L, Swartz MN. Pathological properties of invading organisms. In: Soderman WA Jr, Soderman WA, editors. *Pathological physiology: Mechanisms of disease.* Philadelphia: WB Saunders; 1974. p. 457–72.

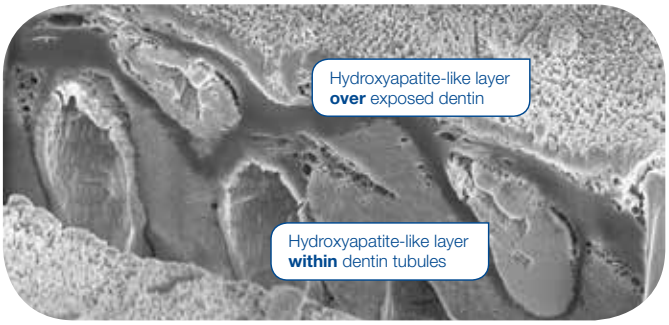
Conference paper

Calder BL, Sawatzky J. A team approach: Providing off-campus baccalaureate programs for nurses. In: Doe AA, Smith BB, editors. *Proceedings of the 9th Annual Conference on Distance Teaching and Learning*; 1993 Sep 13–15, Ann Arbor, MI. Madison (WI): Ann Arbor Publishers; 1993. p. 23–26.

Sensodyne® Repair & Protect

Powered by NovaMin®

NovaMin® forms a robust hydroxyapatite-like layer that's similar to natural tooth enamel over exposed areas of dentin and within dentin tubules.[1–4]



In vitro cross-section scanning electron microscope (SEM) image of hydroxyapatite-like layer formed by supersaturated NovaMin® solution in artificial saliva after 5 days (no brushing).[3]

Adapted from GSK data on file.

Clinically proven to help protect against dentin hypersensitivity[1–4]

On contact with saliva, NovaMin® initiates a cascade of events[1,5]

Rise in pH in the localized environment as a result of ionic exchange[1,5]

Release of calcium and phosphate ions from NovaMin® particles[1,5,6]

SENSODYNE REPAIR & PROTECT

Think beyond sensitivity pain relief when recommending Sensodyne Repair & Protect.

GlaxoSmithKline Consumer Healthcare Inc.
Mississauga, Ontario L5N 6L4

1. Greenspan DC, et al. *J Clin Dent*. 2010;21:61–65. **2.** LaTorre G, et al. J Clin Dent. 2010;21(Spec Iss):72–76. **3.** Earl J, et al. *J Clin Dent*. 2011;22(Spec Iss):62–67. **4.** Parkinson C, et al. *J Clin Dent*. 2011;22(Spec Iss):74–81. **5.** Layer TM. *J Clin Dent*. 2011;22(Spec Iss):59–61. **6.** Andersson OH and Kangasniemi I. *J Biomed Mater Res*. 1991;25:1019–1030.


Medicom®
SafeMask®
NEW
ASTM LEVEL 2
Master Series
Feel the colour
ASTM LEVEL 1
ASTM LEVEL 2
#feelcolor

Scientific or technical report
Murray J, Zelmer M, Antia Z. *International financial crises and flexible exchange rates*. Ottawa: Bank of Canada; 2000 Apr. Technical Report No. 88.

OTHER PUBLICATIONS

Newspaper article
Rensberger B, Specter B. CFCs may be destroyed by natural process. *The Globe and Mail*. 1989 Aug 7;Sect. B:24.

Audiovisual
Wood RM, editor. *New horizons in esthetic dentistry* [videocassette]. Chicago: Chicago Dental Society; 1989.

Unpublished material
Smith A, Jones B. The whitening phenomenon. *J Nat Dent*. (Forthcoming 2004)

ELECTRONIC MATERIAL

Monograph on Internet
National Library of Canada. *Canadiana* quick reference [monograph on the Internet]. Ottawa: The Library; 2000 [cited 2015 Feb 16]. Available from: www.nlc-bnc.ca/8/11/index-e.html

Journal on Internet
Walsh MM. Improving health and saving lives. *Dimens Dent Hyg* [Internet] 2003 Nov/ Dec [cited 2015 May 1]. Available from: www. dimensionsofdentalhygiene.com/nov_dec/saving_lives.htm

Homepage/website
Canadian Dental Hygienists Association [website]. Ottawa: CDHA; 1995 [cited 2015 Sep 25]. Available from: www.cdha.ca

Instructions aux auteur(e)s

Le *Journal canadien d'hygiène dentaire* (JCHD) est une publication révisée par les pairs de l'Association canadienne des hygiénistes dentaires. Publié tous les quatre mois, le journal invite la présentation de manuscrits en anglais et en français sur des sujets relevant de la pratique, la théorie, la formation et la politique de l'hygiène dentaire. Les manuscrits devraient traiter de sujets d'actualité afin de contribuer de façon significative à l'ensemble des connaissances en hygiène dentaire et de faire progresser les bases de la pratique. Toute demande de renseignements préalables et toutes les soumissions doivent être adressées au journal@cdha.ca.

Catégories de manuscrits

1. **Articles de recherche originaux :** maximum de 6 000 mots, pas plus de 150 références et un résumé limité à 250 mots.
2. **Revues de la littérature :** entre 3 000 et 4 000 mots, limite de 150 références et un résumé limité à 250 mots.
3. **Communications courtes/Rapports de cas :** maximum de 2 000 mots, autant de références que nécessaire et un résumé limité à 150 mots.
4. **Exposés de principe :** maximum de 4 000 mots, pas plus de 100 références et un résumé limité à 250 mots. Cette catégorie comprend les documents de prise de position de l'ACHD.
5. **Lettres à la rédactrice :** maximum de 500 mots, pas plus de 5 références et 3 auteurs. Pas de résumé.
6. **Éditoriaux :** sur invitation seulement.

Les détails des composantes requises pour chaque catégorie de manuscrit peuvent se trouver sous « Préparation de manuscrit » dans www.cdha.ca/cjdh.

Sujets des manuscrits

Le JCHD accueille vos textes originaux concernant :

- *Le professionnalisme :* éthique, responsabilité sociale, questions juridiques, entrepreneuriat, aspects commerciaux, maintien de la compétence, assurance de la qualité et autres sujets selon les paramètres généraux de la pratique professionnelle.
- *La pratique clinique :* procédures des soins d'interception, de thérapie, de prévention et de constance pour maintenir la santé buccodentaire.
- *Les sciences de la santé buccodentaire :* connaissance des sciences de base soutenant la pratique de l'hygiène dentaire.
- *La théorie :* concepts ou processus de l'hygiène dentaire
- *La promotion de la santé :* politique publique et éléments faisant partie intégrante du développement des capacités aux niveaux individuels, des groupes ou des sociétés en général, comme la création d'environnements de soutien à l'apprentissage, le développement des capacités, le renforcement des

activités communautaires et la réorientation des services buccodentaires.
- *La formation et l'évaluation :* l'éducation et l'apprentissage aux niveaux individuels, des groupes et des collectivités (comprenant la formation concernant la clientèle, les professionnels de la santé buccodentaire, de même que l'évaluation des programmes, la planification, la mise en œuvre et l'évaluation).

Veuillez noter que les manuscrits soumis au JCHD doivent être des œuvres originales de la part de chacun(e) des auteur(e)s et ne devraient pas avoir été revus ni publiés précédemment par tout autre organisme sous forme écrite ou électronique. Cela ne comprend pas les résumés préparés pour ou présentés à une réunion scientifique et subséquemment publiés dans les procédures. Le Code de déontologie concernant les auteurs, les conflits d'intérêt, l'éthique de la recherche et l'inconduite universitaire est accessible en ligne à www.cdha.ca/cjdh. Veuillez consulter ce document avant de soumettre votre manuscrit.

L'examen par les pairs : Tous les textes sont d'abord examinés par la rédactrice scientifique qui veille à ce qu'ils respectent le mandat du journal et répondent à nos exigences de soumission. Les textes retenus sont alors soumis à l'examen par des pairs, deux ou plus. Cette procédure s'applique aussi aux documents de prise de position formulés par l'ACHD, étant donné qu'ils impliquent une analyse de la littérature. L'on peut aussi solliciter au besoin l'avis d'un spécialiste additionnel (par exemple, un statisticien).

La révision : Lorsqu'un manuscrit est renvoyé à l'auteur correspondant pour révision, la version remaniée devrait être soumise dans un délai de 6 semaines après la réception par l'auteur du rapport des examinateurs. Le ou les auteur(e)s devraient expliquer par lettre de couverture comment les révisions demandées ont été abordées ou, le cas échéant, pourquoi ces personnes n'en ont pas tenu compte. Un manuscrit remanié soumis de nouveau après la période de 6 semaines peut être considéré comme une nouvelle soumission. Sur demande, on pourrait alors accorder plus de temps de révision, à la discrétion de la rédactrice scientifique.

La Maquette comprend des illustrations, graphiques, chiffres, photographies et tout autre graphisme qui soutient et rehausse le texte. L'iconographie doit être fournie dans son format original (comme source d'origine). Les formats du fichier comprennent .eps, .pdf, .tif, .jpg, .ai, .vdr en haute résolution, appariés pour la reproduction imprimée :
- minimum de 300 dpi pour échelles de gris ou demi-teintes de couleurs
- 600 dpi pour les modes de trait
- 1 000 dpi minimal pour la forme d'un bitmap
- toute illustration en couleur soumise au mode couleur CMYK (et non RGB)

Liste de vérification pour la soumission des manuscrits

Coche	Lettre de présentation
	Originalité du travail et déclaration de tout conflit d'intérêt
	Fourniture des coordonnées de l'auteur(e)-ressource
Coche	**Manuscrit**
	Texte présenté en caractères clairs, comme *Arial* ou *Times New Roman*, à double espace et en 12 points de taille.
	Toutes les marges de 1 pouce (2,5 cm).
	Pages numérotées consécutivement, à partir de la page titre.
	Noms entiers des auteurs, grades universitaires et affiliations listés sur la page titre.
	Coordonnées de l'auteur(e)-ressource inscrites sur la page titre.
	Liste des mots-clés des *Medical Subject Headings* (MeSH), base de données www.nlm.nih.gov/mesh/meshhome.html, inscrite après le résumé.
	Abréviations et unités conformes au Système international d'unités (SI). Les symboles SI peuvent être utilisés sans définition dans le corps du texte. Les abréviations sont définies entre parenthèses à la première mention.
	Les figures et tableaux sont numérotés consécutivement, cités dans le texte et insérés à la fin du manuscrit.
	Les tableaux ou figures publiés précédemment sont accompagnés du consentement écrit de la personne détenant le droit d'auteur (ordinairement l'éditeur ou éditrice) autorisant la reproduction du matériel dans les versions imprimées et en ligne du JCHD.
	Toute information (texte ou images) identifiant des clients ou des sujets de recherche est accompagnée d'un consentement écrit de la ou des personnes concernées de publier l'information dans le JCHD.
	Les références dans le texte sont numérotées et listées dans l'ordre de parution.
	Les références sont présentées selon le style de Vancouver (www.nlm.nih.gov/bsd/uniform_requirements.html), utilisant les titres abréviés des revues.
	Les communications personnelles ne sont pas incluses dans la bibliographie mais elles sont citées entre parenthèses dans le texte. La confirmation de la permission d'imprimer la citation est incluse dans la section Remerciements.

L'auteur(e) ou les auteur(e)s doivent prouver avoir reçu de la source originale la permission de reproduire les illustrations précédemment produites et en indiquer la source dans la légende. Le bureau de la rédaction se réserve le droit de reporter la publication d'un manuscrit accepté, en cas de délais d'obtention des permissions ou d'illustrations de qualité d'impression convenable.

Les **données** ou les **tableaux** doivent être soumis en formats Excel ou Word.

Information complémentaire

L'information complémentaire est un matériel revu par les pairs et relevant directement des conclusions d'un

article, qui ne peut pas être inclus en version imprimée à cause de contraintes d'espace ou de format. Affichée dans le site Web du journal et reliée à l'article lorsque celui-ci est publié, elle peut comprendre un texte, des figures, des vidéos, de larges tableaux ou des annexes. Les sources d'information supplémentaire devraient être reconnues dans le texte et la permission de les utiliser, envoyée au bureau de la rédaction lors de la soumission. Toute information supplémentaire devrait être dans sa forme définitive car elle ne sera pas révisée et paraitra en ligne comme son original.

EXEMPLES DE RÉFÉRENCES ET DE CITATIONS

Comme la plupart des revues biomédicales et scientifiques, le JCHD utilise le style de citation de Vancouver pour ses références, lequel a été établi par le Comité international des rédacteurs de revues médicales en 1978. Les références doivent être numérotées consécutivement dans l'ordre de leur première mention dans le texte. Utilisez le numéro précédemment attribué pour la référence des citations subséquentes (i.e., pas de "op cit" ni de "ibid"). Utilisez les chiffres arabes en exposant pour identifier la référence dans le texte (e.g.,[1,2] ou [3–6]). Pour plus d'information sur ce style et les exigences de préparation et de soumission des manuscrits, consultez www.nlm.nih.gov/bsd/uniform_requirements.html. Voici des exemples sur la façon de citer quelques ressources communes de recherche.

ARTICLES DE JOURNAUX

Article standard
Orban B, Manella VB. A macroscopic and microscopic study of instruments designed for root planing. *J Periodontol*. 1956;27:120–35.

Volume avec supplément
Orban B, Manella VB. A macroscopic and microscopic study of instruments designed for root planing. *J Periodontol*. 1956;27 Suppl 7:S6–12.

Compte-rendu de conférence – Résumé
Austin C, Hamilton JC, Austin TL. Factors affecting the efficacy of air abrasion [abstract]. *J Dent Res*. 2001;80(Special issue):37.

Pas d'auteur
What is your role in the profession? [editorial] *J Dent Topics*. 1999;43:16–17.

Organisation comme auteur
Canadian Dental Hygienists Association. Policy framework for dental hygiene education in Canada. *Probe*. 1998;32(3):105–7.

LIVRES ET AUTRES MONOGRAPHIES

Auteurs personnels
Hooyman NR, Kiyak HA. *Social gerontology: A multidisciplinary perspective*. 6th ed. Boston: Allyn & Bacon; 2002.

Éditeurs comme auteurs
Cairns J Jr, Niederlehner BR, Orvosm DR, editors. *Predicting ecosystem risk*. Princeton (NJ): Princeton Scientific Publications; 1992.

Chapitre d'un livre
Weinstein L, Swartz MN. Pathological properties of invading organisms. In: Soderman WA Jr, Soderman WA, editors. *Pathological physiology: Mechanisms of disease*. Philadelphia: WB Saunders; 1974. p. 457–72.

Texte de conférence
Calder BL, Sawatzky J. A team approach: Providing off-campus baccalaureate programs for nurses. In: Doe AA, Smith BB, editors. *Proceedings of the 9th Annual Conference on Distance Teaching and Learning*; 1993 Sep 13–15, Ann Arbor, MI. Madison (WI): Ann Arbor Publishers; 1993. p. 23–26.

Compte-rendu scientifique ou technique
Murray J, Zelmer M, Antia Z. *International financial crises and flexible exchange rates*. Ottawa: Bank of Canada; 2000 Apr. Technical Report No. 88.

OTHER PUBLICATIONS

Article de journal
Rensberger B, Specter B. CFCs may be destroyed by natural process. *The Globe and Mail*. 1989 Aug 7;Sect. B:24.

Audiovisuel
Wood RM, editor. *New horizons in esthetic dentistry* [videocassette]. Chicago: Chicago Dental Society; 1989.

Matériel non publié
Smith A, Jones B. The whitening phenomenon. *J Nat Dent*. (Forthcoming 2004)

ELECTRONIC MATERIAL

Monographie sur Internet
National Library of Canada. *Canadiana* quick reference [monograph on the Internet]. Ottawa: The Library; 2000 [cited 2015 Feb 16]. Available from: www.nlc-bnc.ca/8/11/index-e.html

Revue sur Internet
Walsh MM. Improving health and saving lives. *Dimens Dent Hyg* [Internet] 2003 Nov/ Dec [cited 2015 May 1]. Available from: www. dimensionsofdentalhygiene.com/nov_dec/saving_lives.htm

Page d'accueil ou site web
Canadian Dental Hygienists Association [website]. Ottawa: CDHA; 1995 [cited 2015 Sep 25]. Available from: www.cdha.ca

Submit Your Manuscript for Immediate Impact & Global Visibility

The *Canadian Journal of Dental Hygiene* (CJDH) invites submissions of original research, literature reviews, and short communications on topics of relevance to dental hygiene practice, policy, theory, and education.

Published in February, June, and October and distributed to more than 17,500 oral health care professionals in Canada and abroad, CJDH is the journal of choice for researchers, clinicians, educators, and students seeking high-quality, credible information on the science and practice of dental hygiene.

Manuscripts in English or French may be submitted to the editorial office at journal@cdha.ca, and will be sent for peer review by leading experts in the field–a process that usually takes 4 weeks. *Guidelines for authors* and more information about the journal are available at www.cdha.ca/cjdh

CJDH JCHD

Advertisers' Index

For better dentistry

DENTSPLY CANADA

EXCLUSIVE FREE 1-HOUR

ON-DEMAND WEBINARS

ENGLISH & FRENCH AVAILABLE!

Shape Matters PART I - Curved Inserts for Perio
FURCATION ADAPTATION

Implement better ultrasonic techniques immediately!
Curved ultrasonic instruments can enhance clinical outcomes as they offer superior access in furcations, concavities and curved root surfaces. This online tutorial will guide clinicians through the principles of left and right insert selection and adaption in furcations.

Shape Matters PART II - Curved Inserts for Perio
POSTERIOR SEXTANT DEBRIDEMENT

Implement better ultrasonic techniques immediately!
Curved ultrasonic instruments are more perio suited than straight ultrasonic or manual instruments. These instruments can enhance clinical outcomes as they offer superior access in furcations, concavities and curved root surfaces. Building on the principles from Part 1, this tutorial will guide clinicians through extensive adaption of left and right inserts on posterior teeth.

Shape Matters PART III - Curved Inserts for Perio
FULL MOUTH DEBRIDEMENT

In this final webinar in the series, the unique benefits of curved ultrasonic instruments in anterior sextants will be addressed. The previously addressed concepts of curved inserts in furcations and posterior sextants will be built upon as full mouth sequencing of these periodontal gems will be the focus. Suggestions for client-operator positioning are also highlighted.

WWW.CAVITRONWORLD.COM

INSERT RECYCLING PROGRAM

Recycle any 6 Ultrasonic Inserts and Buy 2,
GET 1 FREE!

*Free goods must be of equal or lesser value. Cannot be combined with any other DENTSPLY offer. *Insert Recycling Program - Free Insert Redemption form online.*

Program valid until December 31, 2016.

www.dentsply.ca | 1.877.393.3687 /DentsplyCanada

What reaction do you want?

Caramel, Mint, Cherry and Melon

Learn more and order your FREE SAMPLE www.vocoamerica.com

voco Profluorid Varnish SingleDose

5% NaF

The thin transparent 5% Sodium Fluoride Varnish in a non-messy new delivery system

- Easy non-messy Single Dose delivery system
- Transparent color without yellow discoloration of the teeth
- Great tasting flavors without an unpleasant aftertaste
- Contains no Saccharin, Aspartame or Gluten
- Available in both adult and child dose
- Contains Xylitol

THE DENTAL ADVISOR ++++

MADE IN GERMANY 100%

Call 1-888-658-2584

VOCO THE DENTALISTS

VOCO Canada · toll-free 1-888-658-2584 · Fax 418-847-0232 · infousa@voco.com · www.voco.com