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Changing consumer behaviour:

A case for evidence based dental hygiene practice

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What does research have to do with the clinical dental hygienist?

Katherine Zmetana, DipDH, DipDT, EdD

Scientific Editor, CJDH

You will note that, although not overtly acknowledged, the underlying theme of this issue, of all issues of *CJDH*, is the usefulness and necessity of using research evidence to make good professional decisions.

When we talk about evidence based practice, we are referring to the real life application of research to clinical intervention—whether for direct treatment, preventive measures, or client education. We can see the value of research when it is put into practice, when the stores of knowledge produced and collected by academia go beyond the level of theory and have an impact on human lives.

Clients rely on professional practitioners to provide knowledgeable advice, not only in the care and prevention of gingivitis and periodontitis, which are most closely associated with dental hygiene, but on all concerns related to the oral cavity. Certainly, dental hygienists should not be providing diagnoses on areas outside our scope of practice, but we are responsible for fulfilling the role of an important consultant within the oral healthcare team.

This past century has seen the birth and growth of the "scientific way". And recent decades have seen technological advances that have been astounding. If we find ourselves doing the same thing, the same way, based on learning and assumptions that date back twenty years, without questioning why, then we need to give our heads a shake and make sure we can justify why, or find out if there's a better way. Nothing stays the same; that's why we need research and why we need researchers.

This issue brings a collection of articles from authors who have taken just that route. Curious about a topic of particular interest and unsatisfied with their own lack of solid information to give confident advice, they went in search of answers to their questions.

A compelling letter to the editor on the subject of dysphagia illustrates one dental hygienist's commitment to continuing competence and professional growth of the practice. **Shannon Collins** shares her cursory review of the literature on dysphagia and oral health, quality of life, and interprofessional collaboration. Difficulty in swallowing can be an unpleasant side effect of growing older; the dental hygienist may be the first one to become aware of a client's discomfort and concern. It can be perplexing to know just how to provide care and assistance for this condition. Treatment differs between hospital and clinical practice settings, and depends on etiology and severity. An informed dental hygienist can assist in the referral process and help the client to make his or her own informed choices.

On a similar note, **Dr. Jana Rieger,** unsatisfied with the seeming lack of effective interventions for sufferers of dry mouth, undertook a review of recent advances in the prevention and treatment of xerostomia. This affliction can be bewildering to cancer patients and to those on certain medications. Improvements in conventional practice have shown promise, particularly in preventing the condition, but finding ways to manage an existing condition can be daunting. Surprisingly, interventions that have been studied and shown effective results include unconventional approaches such as acupuncture. An important finding is that subjective perceptions of dry mouth can be more troubling to the client than the actual severity of hyposalivation. It stands to reason that a dental hygienist who is mindful of such variables can provide better client centred care.

Frieda Pickett has contributed the first article to be featured in our new section, Short Communication. She provides a succinct review and summary of the American Dental Association's Council on Scientific Affairs recommendations for non fluoride anticaries products. These recommendations are based on a thorough systematic review of the subject. The dental profession has become perhaps complacent in the adoption of fluoride as the mainstay of caries management; yet many clients, for a variety of reasons, may request alternatives. While fluoride toothpaste, topically applied fluorides and fluoridated water are proven strategies, it is important to consider client concerns as well as the breadth of options available. Rather than offering personal opinion, providing objective information can be more accessible and acceptable to clients. Sometimes, a combination of modalities might be

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proposed. For example, a client with aggressive root caries may be interested to know the consequences of various choices. The question we might better ask is: In what situations would these adjuncts best be used?

From the Student Corner, **Erica Zammit** considers the somewhat controversial use of lasers in oral hygiene practice. I say controversial, because many practitioners claim that there is still not enough information to merit the use of this expensive equipment, while others who have been using "laser hygiene" are claiming a multitude of immediate benefits for their clients and even more in follow up care. It seems only natural that a review of the literature would be a first step in determining what action to take. Research can at the very least warn of possible complications or assure that no harm is being done. Gaps in available literature may indicate the need for further study—an invitation for future researchers to fill in these gaps.

Andrea Laltoo and **Lindsay Pitcher** performed a sample study on the oral health needs of Canadian prisoners, a much neglected segment of the population. Decisions made on healthcare intervention for these clients have implications that touch federal and provincial budgets. On a national level, research can contribute to decisions in policy making and government funding. Definitely, more are needed.

Finally, I would like to echo **Arlynn Brodie's** message that research is a two way street. Research provides oral health practitioners with evidence that can be put to use in daily decision making. By the same token, observations in everyday practice can be used to formulate questions for study. Our own experience and intuition provide us with knowledge that can be applied and passed on; we need to make good use of that knowledge in putting our theories and practices to test. Research can provide us with hard evidence that supports what we have come to know over the years, and it can help to disprove any areas of doubt with solid rationale.

I encourage you to take up the charge as put forth and do your part. Research is essential.

Changing consumer behaviour: A case for evidence based dental hygiene practice

Arlynn Brodie, MHST, BPE, DipPSM, RDH

CDHA President

Dental hygienists are primary healthcare providers; it is well documented that integrating research in our practice settings is crucial to the development of dental hygiene as a profession. Evidence based decision making has never been so important to the practising dental hygienist. Are dental hygienists in Canada closing the identified research practice gap?[1] If so, who is really driving this closure — is it the dental hygienist or the oral healthcare consumer? I suggest a combination of contributions by the dental hygienist and the client exists; each is providing impetus for a need of evidence based practice growth.

The plethora of oral healthcare information available to its consumers on the Internet and from other media sources has added a new dimension to the role of dental hygienist as an oral healthcare provider. In addition, dental hygienists have to be increasingly discriminating in their quest for evidence because there are so many sources claiming to be "research based".

As educated practitioners, dental hygienists must be able to integrate practitioner expertise with the best available external evidence from research.[1,2]

As students, we are taught to provide treatment based on evidence; but I wonder how well we transition our skill set to our practice environments. Do practising dental hygienists effectively integrate evidence with the process of care?

Recently, I was informed by an elderly client she was using bar soap to brush her teeth. She believed it was a good idea and had gleaned this advice from a radio talk show. Our subsequent discussion revolved around her need for fluoride and how her current practices of homecare did not provide the protection from root caries that she required. The benefits of fluoride for the elderly has been extensively debated and documented;[3,4] so evidence was easily obtained and presented to convince my client, but what about the more challenging questions posed by the public? Are dental hygienists simply replying, "I don't know", or referring the question to another member of the oral healthcare team? The responsibility is ours, as professionals, to rise to the new challenges of online information, and to source out the best evidence available to support our practice. By responding to our clients' health queries, our professional visibility rises with the public we serve and with the oral healthcare team we practise.

In our search for evidence, we will more often reach out to other health professionals; our profile as a valued team player will increase among our interprofessional colleagues, opening opportunities for our further professional growth. Being more visible to our healthcare colleagues and the community will serve to exemplify and illustrate dental hygienists as primary healthcare providers.

The Canadian Dental Hygienists Association supports practice based on current research evidence and has recently modified their "Ends" or goal statement to read, "Members engage in dental hygiene research". The successful integration of our profession of dental hygiene with the interprofessional healthcare system is contingent on our ability to practise as evidence based professionals.

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Collaboration with health professionals to recognize dysphagia in elderly clients

Dear editor:

The *CJDH* May 2012 issue, volume 46, no.2, brought together excellent articles with a focus on oral–systemic health; these articles encouraged me to share what I had learnt on swallowing difficulties, or dysphagia, from my final project at Camosun College Dental Hygiene Program in British Columbia.

Why I chose to investigate this health condition as a dental hygienist

During a program visit to the Miyagi Advanced Dental Hygienists' College (MADHC), Japan, in July 2010, I learnt that dysphagia management was included in MADHC's dental hygiene process of care. The student case studies we observed demonstrated improved swallow function and oral cavity access with dysphagic elderly clients. I was curious to learn how it is managed in Canada, and how dental hygienists integrate this aspect of care in practice.

From a personal perspective, my parents were among the first group of baby boomers to become senior citizens in 2011. I was inspired to learn how becoming more aware of age related health conditions could benefit my clients.

How I gathered information

After a cursory review of the literature, I interviewed three community dental hygienists of Vancouver Island Health Authority (VIHA). My primary mentor provides services in long term care facilities, and I shadowed her as she cared for her client with dysphagia, related to multiple sclerosis. I also observed another dental hygienist while she worked with two clients in a government subsidized group home, and I received guidance from the third dental hygienist to utilize the *VIHA Oral Care Guidelines for Children with Swallowing Difficulties/Dysphagia* to form health history questions for my elderly clients at the Camosun College Dental Clinic. I also conducted phone and email interviews with a VIHA speech-language pathologist, a VIHA occupational therapist, a general practice physician, and the senior instructor at MADHC, Japan.

What I learned: Dysphagia etiology, signs, health risks, and treatment

The pathology of dysphagia can be complicated because dysphagia is not a disease itself; it is a sign of an underlying condition. Stroke, gastroesophageal reflux disease, upper gastrointestinal tract cancers, chronic obstructive pulmonary disease (COPD), congestive heart failure, head injury, neurological disorders, and neuromuscular disorders can present as dysphagia. The oral, pharyngeal, and esophageal peristalsis muscles overlap and work in combination; if one group of muscles starts to atrophy, it affects the entire swallowing process. Non pathological, age related transformations in swallowing function are prevalent in the elderly and are called presbyphagia. Presbyphagia results from decreased lingual strength as muscle tissue is gradually replaced by adipose and connective tissue, age related reduced fine motor skills, poor posture while eating, reduced dentition, and difficulty chewing with dentures.

The foremost signs are choking or coughing during swallowing, and a history of recurrent respiratory infections. Obicularis oris muscular tension is common and can hinder access to the oral cavity. Incomplete clearance of food in the mandibular vestibule or dorsal tongue region may indicate dysphagia. Reduced saliva control can cause a wet sounding voice.

The most serious health risk for elderly with dysphagia is aspiration and colonization of Gram negative oral bacteria in the lungs, which when combined with compromised immunity, often lead to exacerbation of COPD and an increased pneumonia mortality rate. Other risks are asphyxiation from upper airway obstruction, increased risk of periodontal disease and caries from incomplete food clearance, dehydration, weight loss, malnutrition, and decreased quality of life.

An interdisciplinary approach can help improve swallowing function. Speech

Table 1. Considerations for integrating unmet needs related to signs of dysphagia into the dental hygiene process of care. Developed from a cursory review of the literature and opinions of local community dental hygienists who mentored my project.

Assessment
- Collaborate with office colleagues to see if health history forms ask about recurrent pneumonia/respiratory infection.
- When asking clients to swallow during palpation of the thyroid and hyoid in the extra oral exam, ask:
  - Does it take a while for food to clear the back of your throat?
  - Do you often choke while eating or drinking?

Diagnosis of unmet human needs
The following utilizes the Human Needs Theory to diagnose unmet needs related to signs of dysphagia.
- Health risks
  - Respiratory infection from aspirating pathogenic bacteria
  - Increased risk of periodontal disease and caries from incomplete food clearance
  - Asphyxiation from choking
  - Dehydration, weight loss, malnutrition
  - Decreased quality of life
- Freedom from discomfort or pain during swallowing
- Skin and mucous membrane integrity of the head and neck—soft tissues can be affected by xerostomia or ill fitting dentures
- Biologically sound and functional dentition—stagnant food debris increases risk of caries and periodontal disease.
- Conceptualization and problem solving dysphagia health risks

language pathologists provide individualized care with interventions such as body positioning during eating and drinking, breath holding and swallowing exercises, electrode stimulation, and food texture and temperature recommendations. Environment redesign and body positioning are provided by occupational therapists. Dieticians often collaborate with speech-language pathologists to ensure that recommended foods provide adequate nutritional value. Physicians may prescribe adjunctive pharmacological therapy. The literature recommended daily mechanical disturbance of dental biofilm coupled with professional periodontal maintenance to decrease aspiration pneumonia. I began to get an idea of the complexity of treatments involved in dysphagia management, and realized that dysphagia management is a highly individualized process.

Ideas for integrating dysphagia into the dental hygiene process of care

It is not within the Canadian dental hygiene scope of practice to assess or treat swallowing difficulties. By recognizing signs of dysphagia, however, dental hygienists can help reduce health risks through the dental hygiene considerations listed in Table 1. To help prevent health risks in early dysphagia, these considerations could also be implemented for clients with any of the medical conditions underlying dysphagia.

Conclusion and evaluation of my project

When working towards the goal of achieving a higher quality of life for our aging population, collaboration among health professionals through treatment planning could be beneficial; the massage techniques implemented by MADHC students decreased oral muscle tension enough to facilitate oral care. This demonstrated a benefit of speech-language pathologist therapy directly preceding a dental hygiene appointment.

Limitations of my project were the omission of clinical dysphagia assessment tools, scales for measuring swallowing function, laryngopharyngeal sensory deficits, and not differentiating oral and pharyngeal disorders. I had expected to begin my career in private practice, so my approach focused on dysphagia awareness in a clinical setting and excluded collaboration with caregivers, which many dysphagic stroke patients require for personal hygiene.

During my first year in practice, several of my clients reported swallowing difficulties. The majority were not aware of potential health risks, potential underlying health conditions, or dysphagia treatment options. To enhance care provision for elderly clients, I feel it is important for dental hygienists to be aware of dysphagia signs, educate affected clients of potential health risks, practice aerosol reduction, encourage physician involvement, and inform clients that treatment options exist.

Yours sincerely,
Shannon Collins, RDH
Email: shannon.mae.collins@gmail.com

Table 1. *continued*

Planning and implementation • To help prevent aspiration of potentially fatal pathogens, assist clients in making informed decisions about their professional dental hygiene care and home self care: - Reduce the incidence of aspiration pneumonia by encouraging a preprocedural rinse with 0.12% chlorhexidine gluconate. - Recline clients halfway rather than fully supine to help prevent saliva aspiration. - Avoid creating aerosols by avoiding cavitron use and prophylactic polish. Recommend a manual toothbrush rather than an electric toothbrush for home care. - The Plak-Vac is a home care toothbrush with a built in suction to reduce aerosols and is available for purchase online through Trademark Medical. Child sized toothbrushes can increase access to teeth if oral muscle tension limits self care. • Clients who experience pain, discomfort, or choking during eating or drinking can be referred to their physician. • Recommend that ill fitting dentures be evaluated by a dentist for adjustment. • Conceptualization of the potential health risks associated with dysphagia can be met through education on awareness and risk reduction. • Problem solving can be attempted through discussing the pros and cons of the above considerations, as they might entail behavioural changes for clients.
Evaluation • Follow up with clients at continuing care appointments to evaluate any of the above implementations that were carried out.

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Recent advances in the prevention and treatment of xerostomia: a review of the literature

Jana M. Rieger, PhD

ABSTRACT

Objective: Xerostomia—whether a result of treatment for head and neck cancer, or disease states such Sjögren's, or side effects of medication—has a devastating impact on quality of life. Thus, it is imperative that health professionals who work with patients afflicted by xerostomia understand the most current interventions, both preventive and therapeutic. **Method:** A Medline search was undertaken to understand advances in this field. Forty-five journal articles, which reported on recent advances in the prevention and treatment of xerostomia, were reviewed in the literature from January 2008 to July 2011. **Results:** Interventions, described in the literature during this period, included surgery, pharmaceuticals, advanced radiotherapy, salivary substitutes, acupuncture, electrostimulation, and hyperbaric oxygen therapy. In preventing xerostomia, surgical and advanced radiation systems appear to be most promising. In treating xerostomia, the results suggest that many of the interventions promote salivary flow; however, this does not always result in a change in the patient's perception of dry mouth. **Conclusion:** While some of these interventions hold more promise than others, regenerative medicine techniques are currently being applied in animal studies, and may be an important future consideration in the battle against xerostomia.

RESUMÉ

Objet : La xérostomie — qu'elle résulte du traitement d'un cancer de la tête ou du cou, d'un état histopathologique comme le syndrome de Sjögren ou des effets secondaires d'un médicament — a un impact dévastateur sur la qualité de vie. Il est donc impératif pour les professionnelles de la santé soignant des patients affectés par la xérostomie d'en bien connaître les interventions préventives et thérapeutiques les plus courantes. **Méthode :** L'on a entrepris une recherche médicale pour comprendre les progrès dans ce domaine. Quarante-cinq articles de journaux traitant de la prévention et du traitement de la xérostomie ont fait l'objet d'une revue de la littérature entre les mois de janvier 2008 et juillet 2011. **Résultats :** Les interventions, décrites dans la littérature de cette période, comprennent la chirurgie, les produits pharmaceutiques, la radiothérapie de pointe, les substituts salivaires, l'acuponcture, l'électrostimulation et l'oxygénothérapie hyperbare. Pour prévenir la xérostomie, la chirurgie et les systèmes de protonthérapie semblent être les mesures les plus prometteuses. Pour traiter la xérostomie, les résultats suggèrent que plusieurs des interventions favorisent l'écoulement salivaire; toutefois, cela ne modifie pas toujours la perception de la bouche sèche par le patient. **Conclusion :** Alors que certaines interventions sont plus prometteuses que les autres, les techniques de la médecine régénératrice sont actuellement appliquées dans les études chez les animaux, et pourraient faire éventuellement l'objet d'importantes considérations dans la lutte contre la xérostomie.

Key words: xerostomia IMRT; cytoprotective agents; acupuncture; hyperbaric oxygen therapy; submandibular gland transfer

OBJECTIVE

Salivation is overlooked as an essential component of normal function of the human body. However, when this seemingly simple function fails and hyposalivation results, the impact is far reaching. Hyposalivation results from a multitude of causes, the most common being radiation therapy for head and neck cancer, Sjögren's syndrome, and medication side effects. Xerostomia, the perception of a dry mouth, is one complication of hyposalivation. While xerostomia is not always necessarily accompanied by hyposalivation, when salivary flow decreases by 50 per cent or more, xerostomia almost always results.[1,2]

The impact of xerostomia on a patient is multifaceted (Figure 1). At the most basic level is the physical impact—the alterations in the normal state of the oral cavity. These impacts include periodontitis, oral pain and discomfort, and, in the case of head and neck cancer patients, radiation caries.[3] Stemming from these physical events are manifestations that are linked intricately to function. These include consequences such as tooth loss, dysphagia, and cachexia.[4–6] The functional deficits often lead to psychosocial impacts such as avoidance of social contact and events, and poor sleep—all of which have the potential to lead to an overall reduced quality of life.[6,7]

METHODS

A Medline search was conducted for the period between January 2008 and July 2011. After screening, a total of forty-five articles were included for this review.

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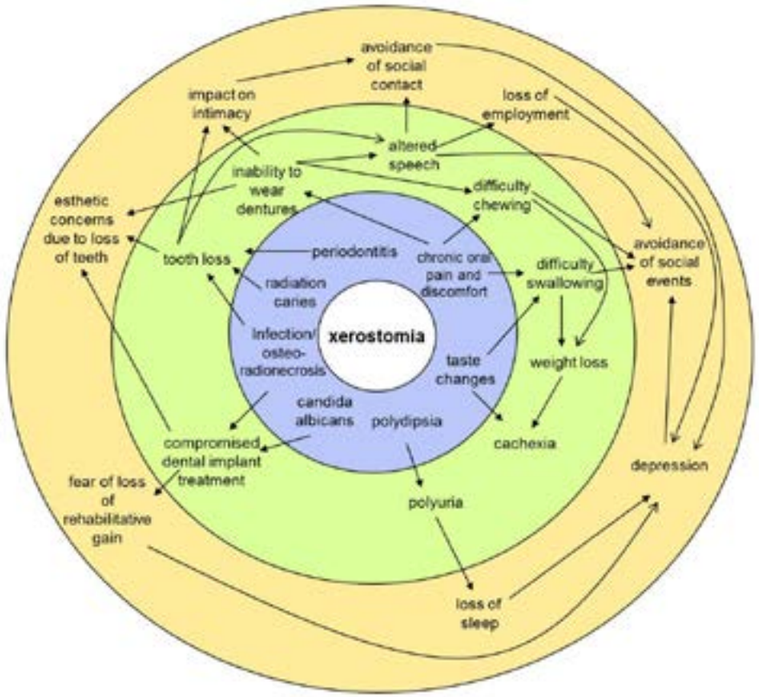
Figure 1: The multifaceted impact of xerostomia on patients.



Search terms included xerostomia treatment, xerostomia prevention, xerostomia and Sjögren's, xerostomia and head and neck cancer, and xerostomia and medication. All articles were screened for their relevance and their reference lists screened for other relevant articles that may not have shown up in the Medline search. Articles were considered relevant if they included a patient population and a specific intervention for xerostomia. In addition, studies that examined experimental treatments in animal populations also were included. Furthermore, reference lists of review articles were screened for relevant articles.

RESULTS AND DISCUSSION

Prevention of xerostomia

Reports related to the efficacy of surgical, pharmaceutical, and radiotherapeutic treatments are emerging to provide hope that radiation induced xerostomia can be prevented. Due to the location of primary tumors of the head and neck, the salivary glands are often in the target volume for radical or postoperative radiotherapy. Salivary gland hypofunction develops rapidly when the glands are exposed to radiation, being permanent with little chance for recovery.[8] Preventive treatments are aimed at circumventing the effect of radiation therapy on the salivary glands.

Surgical intervention

The submandibular gland transfer (SGT) is a simple and relatively inexpensive treatment modality. During resection of the primary tumor, or prior to primary chemoradiation, one submandibular gland is transferred into the submental space, which is shielded during radiation therapy, thereby protecting the gland. The technique, supported by research over the past three years, demonstrates efficacious results in the prevention of post radiotherapeutic xerostomia and swallowing function.[6,9,10]

In a five year study that compared the SGT to no intervention during radiation therapy (RT) for nasopharyngeal carcinoma, Liu et al.[10] demonstrated significantly better salivary flow and more positive outcomes related to xerostomia in patients who received the SGT than those who received no intervention. In order to answer how the SGT compares to other preventive treatments, Jha et al.[9] completed a Phase III randomized study, where the SGT was compared to oral pilocarpine administered as a radioprotective agent. These investigators demonstrated that patients who had received the SGT maintained significantly better salivary flow and scored more positively on quality of life questions related to xerostomia than did patients who had received pilocarpine during radiation.[9] In a subset of the Jha patients who were studied for functional outcomes assessed by videofluoroscopy, this translated into better swallowing ability in the SGT group.[6]

While these results are promising, the SGT is not oncologically feasible for certain individuals, including those with cancer of the oral cavity or those with submandibular or submental nodes involved with metastatic cancer. Other preventive modalities, such as pharmaceutical or radiotherapeutic interventions, have been considered as alternatives.

Pharmaceutical intervention

Pharmaceutical interventions were used both during and after RT; those of interest in this section include amifostine and pilocarpine, both used during RT to study their cytoprotective effects.

Amifostine has been studied as a cytoprotective agent more extensively than pilocarpine in the prevention of xerostomia. This is likely due to its history as a cytoprotective agent in cancer clinical trials since 1980. In 1999, the Food and Drug Administration approved its use for patients with head and neck cancer undergoing RT.[11]

The protective mechanism of amifostine is related to its accumulation in normal versus malignant cells, and to its ability to scavenge for oxygen free radicals that cause DNA damage. It was deemed a likely protector for salivary cells because of its considerable accumulation in the salivary glands.[12,13] However, the literature since 2008 reveals mixed results regarding its efficacy.

Haddad et al.[14] completed a randomized phase II study where patients with head and neck cancer receiving chemoradiation either did or did not receive concomitant amifostine. Their results—median follow up of 34 months—revealed no differences in grade of xerostomia, salivary flow, or swallowing outcomes between the two arms of the study. Rudat et al.[15] used salivary gland scintigraphy to assess parotid function preservation in three groups of patients with head and neck cancer: chemoradiation (CRT) with no amifostine; CRT with amifostine; and intensity modulated radiation therapy (IMRT). Investigators found no difference between the two groups in the short term (i.e., 1–12 months) with respect to patients who received CRT with or without amifostine, but a potential long term beneficial effect of amifostine (i.e., 13–47 months).[15] Kim et al.[16] studied the effectiveness of amifostine administration during radioactive iodine treatment for thyroid cancer in a randomized control trial. These investigators found significant decline in salivary function in both the treatment and control group, with no between group differences in perception of dry mouth or in results from scintigraphy after three months and one year.

The results, related to long term protective outcomes of amifostine on salivary gland function, have yet to be definitively proven. In addition, the side effects of amifostine, such as hypotension, nausea, vomiting, and skin rash limit the indications for use of this drug in preventing radiation induced xerostomia.[13]

Pilocarpine, a parasympathomimetic drug that increases secretion of the salivary glands, also has been studied as a protective agent; however, unlike amifostine's scavenging of free radicals during radiation, pilocarpine functions by stimulating certain pathways via muscarinic receptors, which theoretically could result in increased proliferation and repopulation of cells.[11,17] Evidence exists from one recent clinical trial to suggest that pilocarpine may have a beneficial effect for some patients.[18] Burlage et al.,[18] in their double blind, randomized, placebo controlled trial, found that while there were no differences in xerostomia or salivary flow outcomes between pilocarpine and placebo for most patients, those in a subgroup who had received >40Gy to the parotid gland benefitted from pilocarpine—they had significantly better parotid flow than patients who received placebo. Burlage et al.[18] speculated that a certain degree of damage needs to occur to parotid gland cells before the stimulation effects of pilocarpine become apparent on non-damaged glandular tissue. Pilocarpine administration during RT was included as one arm of another randomized control trial that investigated the efficacy of the SGT in relation to pilocarpine.[9] In that study, baseline salivary flow at 6 months after radiation in the pilocarpine group was significantly less than that in the SGT arm. No subgroup analysis was completed that could be used to understand dosing relationships.

As with amifostine, there are conflicting results related to the efficacy of pilocarpine as a cytoprotective agent. For most patients, there is little benefit. Even investigators who have found some benefit suggest that pilocarpine should not be used as a standard preventive treatment, but may be considered where advanced radiation delivery techniques are not available, or where such techniques cannot spare the parotid gland.[18]

Advanced radiotherapeutic interventions

Advanced radiotherapeutic interventions, such as intensity modulated radiation therapy (IMRT), have been studied extensively in recent years. During IMRT, radiation treatment beams of non uniform intensity deliver highly conformal radiation dose distributions to the target volume of interest while sparing normal surrounding tissue. As such, RT can be directed at the lesion site in the head and neck region while sparing the surrounding salivary glands, and theoretically preventing xerostomia. The parotid gland is the one most often spared with IMRT.

Several studies since 2008 have investigated IMRT in relation to conventional RT.[19–25] All of these studies report that patients who underwent IMRT had better outcomes related to xerostomia and salivary flow than those who underwent conventional RT. All but one[21] of these studies analyzed these outcomes in a retrospective manner; however, this does not appear to affect the results. In their prospective phase III multicentre randomized control trial, Nutting et al.[21] showed that at two years, patients who received IMRT had significantly better recovery of saliva secretion and xerostomia specific scores than patients who had received conventional RT. There were no differences in locoregional control or survival.

In a multi institutional longitudinal study of outcomes related solely to IMRT,[26] a xerostomia grade of 2 was observed in approximately half of all patients at 6 months, and fell to 16 per cent at two years after therapy. However,

there was a reduction in stimulated and unstimulated saliva (80% and 86% respectively) at three months after therapy, which only improved minimally at one year after therapy. The literature on IMRT clearly indicates that this technology has advanced the field of xerostomia prevention in head and neck cancer; more than 80 per cent of survivors experienced life altering xerostomia before the introduction of IMRT,[27] and approximately 80 per cent of patients who had received IMRT no longer experienced debilitating xerostomia.[21, 26]

Treatment of xerostomia

For patients with Sjögren's syndrome, or those with head and neck cancer who had no salivary sparing intervention, treatment of xerostomia comes in many forms, including pharmaceutical agents, saliva substitutes, acupuncture, electrostimulation, and hyperbaric oxygen therapy (HBO).

Pharmaceutical agents

In the head and neck population, the use of pilocarpine as a treatment shows mixed results. For example, in a study of thyroid cancer, pilocarpine administration led to an increase in salivary flow; however, most patients were unwilling to continue treatment because of side effects.[28] The results of this study should be interpreted with caution due to the small sample size and lack of baseline salivary flow data. In another study of head and neck cancer patients, 40 per cent had improvement on a visual analogue scale measuring perception of dry mouth at twelve weeks.[29] However, only 47 per cent tolerated pilocarpine, while the rest experienced side effects such as sweating, nausea, rhinitis, headache, and fatigue. Finally, a review of the randomized control trials from 1987 to 2006 that assessed the use of pilocarpine to treat xerostomia revealed that approximately 45 per cent of patients with head and neck cancer experienced symptomatic relief.[30]

Treatment of xerostomia in Sjögren's syndrome involved several different pharmaceutical preparations. The use of pilocarpine has been studied, and the results of a review of randomized control trials between 1991 and 2004 revealed that it was effective in stimulating salivary flow, but not necessarily relieving subjective complaints of xerostomia.[30] However, in a study of juvenile onset Sjögren's, results revealed that pilocarpine improved salivary flow as well as subjective complaints of dry mouth.[31]

Two studies investigated the effect hydroxychloroquine —an antimalarial also used to reduce inflammation— and revealed that there were increases in salivary flow associated with administration of the drug.[32,33] However, subjective complaints of xerostomia did not change.[32] Nizatidine, a histamine H_2 receptor antagonist, was compared to famotidine in Sjogren's patients; results showed that nazatidine resulted in more salivary secretion than famotidine and led to improvements on subjective ratings of xerostomia.[34] In contrast, cevimeline hydrochloride, a parasympathomimetic and muscarinic agonist, was compared to a placebo in patients with Sjögren's, revealing improvements in subjective perceptions regarding dry mouth, but no differences in salivary flow rate when compared to placebo.[35] Finally, it would appear that rebamipide—a mucosal protector that scavenges free radicals—when compared to placebo, affects neither salivary flow rate nor subjective perceptions of dry mouth in patients with Sjögren's syndrome.[36]

Finally, pharmaceutical preparations have been trialled in individuals who have dry mouth of unknown etiology. Physostigmine and nizatidine were assessed, revealing their efficacy in increasing salivary flow and in improving perception of dry mouth.[37,38] Specifically, with physostigmine, a parasympathomimetic alkaloid, there was a six fold relief in ratings of xerostomia and a fivefold increase in salivary flow.[37] Sixty-six per cent of patients improved on ratings of xerostomia after one month of treatment with nizatidine.[38]

Thus, it would appear that the pharmaceuticals used to treat xerostomia are proficient at stimulating salivary flow, and so satisfy a physiological deficit. However, they are less likely to change perceptions of dry mouth. More work, such as that of Dawes,[1] is needed to elucidate the mechanisms that lead to subjective perceptions of dry mouth. In addition, consideration of patient population, and degree of salivary gland dysfunction will be important when interpreting results of these interventions.

Saliva substitutes

The use of saliva substitutes has been studied in several populations, including Sjögren's syndrome, head and neck cancer, the elderly, diabetics, and those with medication induced xerostomia. When an oral lubricant was compared to placebo in a single blind crossover study in Sjögren's syndrome, Alpoz et al.[39] found that patients rated both as having a positive effect on xerostomia, with no differences between ratings related to burning tongue, diminished taste, or waking up at night to sip water. At the end of the study, there was a slight overall preference for the lubricant.[39] Likewise, Gil-Montoya et al.[40] found that placebo and gel and mouthwash formulations were rated as equally good or equally bad at relieving xerostomia when assessed in elderly patients in a randomized, double blind, crossover study.[40]

Although the previous studies showed no effects of saliva substitutes on ratings of xerostomia, their effects on other aspects of oral health have been investigated. For example, Montaldo et al.[41] studied the effects of saliva substitutes on oral health in diabetic patients. They found that patients who did not receive salivary substitutes had a higher risk of gingivitis, positive yeast counts and plaque.[41] Their findings could have been influenced by the design of the study as the experimental group was given specific instructions on how to brush their teeth whereas the control group of diabetic patients was not. In another study, Oh et al.[42] examined the effect of salivary substitutes on a heterogeneous group of patients with xerostomia.[42] In this pre test–post test study, they found that the use of artificial saliva resulted in significant differences in ratings of dryness and effect on daily life. However, there was no control group or placebo administered, making it difficult to reach definitive conclusions about the efficacy of the formulation used in the study.[42]

The literature would suggest that there are improvements in xerostomia frequently reported with the use of salivary substitutes. However, when a placebo is included in the assessment, there is frequently little difference between the salivary substitute and placebo.

Acupuncture

A relatively old form of alternative medicine is emerging as a new treatment in the battle against xerostomia. In the past three years, several studies have emerged to assess the efficacy of acupuncture in relieving dry mouth.

In support of acupuncture as a treatment for xerostomia, there appears to be preliminary evidence that ties neurological outcomes directly to physiological function in response to needling in normal subjects. Specifically, Deng et al.[43] found that sham needling resulted in no activation of regions of interest in the brain as assessed by magnetic resonance imaging (MRI). In contrast, real needling resulted in activation of the insular and operculum regions of the brain. Furthermore, real needling led to significantly higher amounts of saliva production in normal subjects.[43]

Most of the clinical intervention studies have focused on head and neck cancer patients. Cho et al.[44] found that while salivary flow increased somewhat for both sham and real acupuncture, there were no differences between groups. Likewise, while there was a statistically significant improvement in subjective scores of xerostomia for the real acupuncture group, there were no significant differences between groups on this measure either. This suggests that the sham acupuncture group improved somewhat on the subjective measures, but not to the same degree as the real group. One acknowledged flaw of this study was a chance difference at baseline in subjective scores of xerostomia and time since radiation therapy between the real and sham acupuncture groups.[44]

Garcia et al.[45] and Meidell et al.[46] completed longitudinal studies of acupuncture in head and neck cancer and hospice patients respectively. Both groups of researchers found that subjective ratings of xerostomia improved over the course of their studies—at 8 weeks and after 5 treatments respectively—but that salivary flow rates did not change.[45,46] There were no sham interventions in either study to which results could be compared. On the other hand Simcock and Fallowfield[47] found that 50 per cent of patients receiving acupuncture had increases in salivary flow, as well as improvements in quality of life items related to xerostomia in a longitudinal study of group acupuncture.

A systematic review of the literature between 1985 and 2009 on acupuncture for relief of xerostomia in head and neck cancer revealed that patients do seem to receive a subjective benefit from acupuncture.[48] However, as noted by O'Sullivan and Higginson,[48] researchers must strive for greater consistency in acupuncture points, number of sessions, timing of follow up, and a gold standard for the sham condition before any firm conclusions can be drawn. Furthermore, while MRI evidence suggests that neurological responses are elicited by acupuncture,[43] the tie between such neurological responses and salivary production in damaged glands has not been studied.

Electrostimulation

Another relatively new area of study in the treatment of xerostomia involves electrostimulation of the peripheral nerves related to salivation, which is thought to induce the salivary reflex arc by sending a signal through peripheral nerves in the oral cavity to central mechanisms of the brain.[49] Two devices have been studied recently; one a mouthpiece that delivers an electrical current through the oral mucosa upon patient activation with a remote control,[50] and the other a stimulator that is embedded into a dental implant supported crown that is also activated by a remote control.[51] Results from the mouthpiece study revealed that electrostimulation led to better ratings of xerostomia than a sham condition. Furthermore, longitudinal results of the active device revealed significant improvements in ratings of xerostomia, oral discomfort, speech difficulty, sleeping difficulty, and resting salivary flow rate over time.[50] While the mouthpiece device has been tested on a fairly large group of patients, the study on the dental implant supported electrostimulator only included one patient. That patient reported improvements in oral wetness as well as a concomitant increase in salivary flow.[51]

Hyperbaric oxygen therapy

Speculation about the role that hyperbaric oxygen (HBO) therapy could play in the treatment of xerostomia has stemmed from its previously demonstrated effects on angiogenesis and revascularization of tissues.[52] Gerlach et al.[53] studied the effect of HBO on xerostomia in a consecutive series of twenty-one patients with head and neck cancer at one and two years post administration of HBO. Their results revealed a significant improvement in symptoms of xerostomia and saliva quantity at the one year evaluation point. At two years, the significant difference in quantity of saliva remained. In a subgroup analysis at the two year assessment, symptoms of xerostomia were less in patients who had received HBO within one year of RT than in those who received HBO more than one year after RT. [3] However, there was neither a control group nor randomization; thus, it cannot be conclusively stated that it was HBO that effected salivary flow and not simply some degree of recovery or adaptation on the patients' part to their symptoms. Teguh et al.[54] completed a randomized trial to investigate the effect of a standardized protocol of HBO delivered beginning two days within completion of RT on xerostomia. The HBO group had significantly better scores than controls on questions related to xerostomia. While this study was randomized, there was no sham HBO condition, which may have revealed whether or not a Hawthorne effect influenced the results.

CONCLUSION

The literature on the prevention and treatment of xerostomia reveals the advancements in understanding this complex condition made in recent years. One of

the most promising developments in the prevention of xerostomia is the advent of IMRT. Additionally, the SGT is a low cost alternative for certain patients with head and neck cancer who are treated at facilities where the advanced technology needed for IMRT is not available. The evidence to support pharmaceuticals in prevention of xerostomia is not as compelling.

With respect to the treatment of xerostomia, several advances in understanding different interventions have been made. Whether considering pharmaceutical treatment, alternative treatments such as acupuncture, or medical treatments such as HBO, a distinction must be made between promoting salivary flow versus altering patient perception of dry mouth. While salivary flow may be necessary to maintain certain aspects of oral health, the true impact on the patient is, more often than not, the subjective feeling of xerostomia and its detriment to quality of life. Interventional outcomes, must be interpreted in accordance with perceptual outcomes. One new item on the market that has the potential to relieve the discomfort associated with xerostomia, especially at night, is the XEROS dry mouth pump. The device is currently only substantiated by patient testimonials and requires the rigor of scientific evaluation before any conclusions can be drawn regarding its efficacy.

Finally, exciting new areas of regenerative medicine are opening up new possibilities related to salivary gland regeneration using stem cells.[55] While the research is still focused on animal models,[56–58] future application in human clinical trials will be important in advancing the field of prevention and treatment of xerostomia.

Conflict of Interest

The author has no conflict of interest to report.

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Clinical practice recommendations for non fluoride anticaries products: review and summary

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ABSTRACT

Objective: The American Dental Association Council on Scientific Affairs selected an expert panel to review the science regarding efficacy for non fluoride anticaries products and to assist practitioners with decisions on the use of non fluoride caries preventive agents to arrest, prevent or reverse caries. The purpose of this paper is to review and summarize the most important aspects of the panel’s report. **Methods:** The expert panel conducted a systematic review of the literature to answer the following clinical questions: 1. In the general population, does the use of a non fluoride caries preventive agent reduce the incidence, arrest or reverse caries? 2. In individuals at higher caries risk, does the use of a non fluoride caries preventive agent reduce incidence, arrest or reverse caries? **Findings:** The majority of non fluoride agents—xylitol, chlorhexidine, amorphous calcium or casein derivatives, etc.—have weak evidence as anticaries agents and most were not recommended for use. Those recommended were to be used as adjuncts in individuals at high risk of developing caries. **Conclusion:** Only one product, chlorhexidine/thymol varnish, received a recommendation for reducing root caries. One product was graded as having weak evidence for implementation—sucrose free polyol–xylitol only or polyol combinations chewing gum—for coronal caries reduction. The panel strongly recommended that practitioners first implement evidence based anticaries products or practices —fluoride, sealants, dietary practices limiting sugar consumption— before attempting to use non fluoride adjunctive therapies.

RESUMÉ

Objet : Le Conseil des affaires scientifiques de l’Association dentaire américaine a chargé un comité d’examiner les connaissances sur l’efficacité des produits anticaries non fluorés et d’aider les praticiens à décider de l’emploi d’agents non fluorés pour prévenir ou inverser les caries. Cet article revoit et résume les aspects les plus importants du compte-rendu du comité. **Méthodes :** Le comité d’experts a revu systématiquement la littérature pour répondre aux questions cliniques que voici : Dans la population en général, l’emploi d’un agent de prévention non fluoré réduit-il l’incidence de la carie, l’arrête-t-il ou l’inverse-t-il ? Chez les personnes à risque plus élevé de carie, l’emploi d’un agent de prévention non fluoré réduit-il l’incidence de la carie, l’arrête-t-il ou l’inverse-t-il ? **Résultats :** La majorité des agents non fluorés — le xylitol, la chlorhexidine, le calcium amorphe ou les dérivés des caséines, etc. — ont démontré qu’ils étaient de faibles agents anticarie et la plupart n’ont pas été recommandés. Les agents recommandés devaient servir de compléments chez les personnes à risque élevé de développement de caries. **Conclusions :** Un seul produit, le vernis chlorhexidine/thymol, a été recommandé pour réduire les caries radiculaires. Un produit — le polyol–xylitol sans saccharose seul ou la combinaison de polyol avec gomme à mâcher — a été noté comme ayant démontré une faiblesse d’application pour réduire les caries radiculaires. Le comité recommande vivement aux praticiens d’appliquer d’abord les données fondées sur les produits ou les pratiques anticaries — fluorure, scellants, pratiques diététiques limitant la consommation de sucre — avant de tenter d’utiliser les thérapies d’accompagnement non fluorées.

Key words: caries; preventive dentistry; non fluoride caries prevention

INTRODUCTION

A standard of care for health professions is to develop clinical practice guidelines based on the most reliable science. As well, health professionals must develop skills as scientists to identify reliable study designs and correctly interpret data presented within studies. In addition, oral health professionals must be aware that product claims may not represent product efficacy.[1] The current trend is to be aware of best practices for intraoral procedures for delivery of optimal clinical care to clients. Clients expect the clinician to be aware of new therapies with improved outcomes when compared to older, traditional therapies,[2] to offer effective treatment options, and to consider the financial burden to the client. Information changes over the years and new evidence based treatment options must be considered. The systematic review (SR) is the highest level of evidence for scientific investigation.[3]

The American Dental Association, Council on Scientific Affairs formed an expert panel of eighteen researchers and clinicians to conduct an SR to evaluate the evidence regarding non fluoride products available in the United States, promoted to have an anticaries effect.[4] The panel’s report was further reviewed by twenty one additional scientists, policy experts and committees.[4] The panel evaluated studies of sucrose free polyol chewing gums, xylitol dentifrices, chlorhexidine, chlorhexidine in combination with thymol, calcium containing agents, phosphate containing agents, casein derivatives, sialogogues, iodine and triclosan. This panel presented evidence based clinical recommendations[4,5] for products, but stipulated they be used as adjuncts to primary anticaries

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strategies and in individuals at high risk of caries. A summary of findings regarding the efficacy of non fluoride agents in reducing the incidence of caries and arresting or reversing the progression of caries was published.[5] The recommendations are not to be considered a standard of care but should serve as a guideline for practitioners. This paper will review the recommendations of the expert panel completing the SR and the levels of evidence for products.[4,5]

METHODS

The systematic review included an evidence summary for 66 studies whose authors described 51 randomized controlled trials (RCTs) and 15 non randomized studies assessing the efficacy of various non fluoride caries preventive agents. Most studies were conducted in countries outside the United States and Canada, in communities with low levels of fluoride in the water supply. Limitations of the review of studies were that participants often used fluoridated toothpaste, or had received regular dental care that included in office fluoride therapies, or had been subjected to both events.[4]

Process for developing clinical recommendations

Evidence statements were based on the body of evidence and on the level of certainty of the evidence—graded high or moderate or low—on the basis of a standardized grading system to reflect the quality of scientific evidence to support the clinical recommendation developed from this evidence. Adverse events reported in the trials were assessed, and the panel discussed any potential adverse events that could be associated with the intervention based on knowledge of the existing literature. A simple majority vote was used to make final determinations when a consensus was unable to be reached in interpreting evidence for clinically relevant recommendations, or when recommendations were made based largely on expert consensus. The recommendation in this case was given an "expert opinion" level of strength. Definitions for the various levels of evidence are included in the clinical guideline.[5]

Primary anticaries strategies

An important component of the SR[4] was the recognition of reliable evidence supporting products or dietary practices with proven anticaries benefits. The report began with the statements, "The use of fluoridated toothpastes, other topically applied fluorides, fluoridated municipal water and pit and fissure sealants, along with dietary improvement, remain mainstays of caries management. These modalities, which are based on high quality evidence, are the first choice for prevention and control of dental caries."[4] *It is essential to note these proven strategies are to be the first choice when planning an anticaries program in practice*. Adjunctive agents are recommended for individuals with a high risk of caries.

RESULTS

Recommendations for non fluoridated products

Sucrose free polyol chewing gums versus no gum

Fifteen trials were reviewed, including nine RCTs, to assess the efficacy of sucrose free, polyol chewing gums for caries prevention.[4] The polyol gums used in trials included sorbitol only, xylitol only or polyol combinations. Trial designs used these agents with a comparison group that was not given gum. A limitation of all 15 studies was that participants were not enrolled based on individual caries risk. When quality of study design was assessed, two studies were rated to be of good quality, four studies of fair quality, and the remaining studies were judged to be of poor quality. Nine studies were combined for a metaanalysis (MA). Six studies were excluded from the MA for incomplete reporting of data or for comparisons to sealants, toothpaste or to a non comparable outcome measure. The panel[4] also attempted to determine if outcomes varied between different polyol sweeteners. The MA of studies recording caries in permanent teeth indicated a statistically significant reduction in caries with the use of sucrose free polyol gums compared with no gum chewing. The preventive effect varied between all types of polyols. Subgroup analyses showed that xylitol gum had the highest caries reduction, followed by gums with a combination of polyols. One SR reported the total grams of xylitol consumed per day influenced caries prevention.[6] Significant statistical heterogeneity (I^2 = 95%), was found among studies included in the MA, confirming clinical and methodological differences.[6] It is biologically plausible that the act of chewing and the production of increased salivation could be responsible for the beneficial effects reported. Since all studies had the "no gum" comparison, the effect of salivary stimulation from chewing was unknown. The low quality of most studies limited the panel's confidence in the observed results; however the number of studies showing a consistent preventive effect led the majority of the panel to conclude with moderate certainty, "In children aged 5 – 16 years, supervised consumption of chewing gum sweetened with sucrose-free polyol (xylitol only or polyol combinations) for 10 – 20 minutes after meals marginally reduces incidence of coronal caries."[4,5]

Potential adverse effects of gum chewing were considered as chewing gum raises a potential choking hazard. The American Academy of Pediatrics (AAP) recommends against gum chewing by children younger than four years of age.[7] Children of this age group or children with chewing or swallowing disorders are at greater risk of food related choking. In addition, special attention must be considered for choking prevention among children with neurologic impairments regardless of the age. Behavioral factors may also affect a child's risk for choking.[7] Therefore, chewing gum use should be reserved for neurologically healthy children five years and older, able to chew for an extended time period. Gastrointestinal effects of xylitol in large doses could pose an adverse effect for some individuals. When adverse effects were considered, the majority of the expert panel determined that the benefits of supervised gum chewing added to a caries prevention regimen. When the evidence was extrapolated to adults at higher risk of developing caries, expert opinion recommended chewing sucrose free polyol gum—containing either xylitol only or polyol combinations—after meals.

Polyol candy, lozenges, syrup

Four studies were selected evaluating the effects of xylitol in candy, lozenges, or tablets, and one study evaluating syrup. One study comparing xylitol lozenge to fluoride varnish was not included in the MA; it specifically enrolled high risk subjects and reported non significant difference between the groups. The studies in the MA compared xylitol dose forms to no candy, and found a statistically significant effect in favor of xylitol. Participants sucked on tablets three times daily for 10 minutes. Participants were not assessed for caries risk. Of the three studies, one was judged to be of good quality, one fair, and the third of poor quality. Based on the limited number of studies and on expert opinion the panel concluded with low certainty, "In children reporting caries experience, consumption of xylitol containing lozenges or hard candy reduces incidence of coronal caries."[4]

When the evidence for xylitol syrup was examined, one well designed study was found. This study reported a statistically significant anticaries effect for children aged 2 or younger. However, since only one study was found the panel concluded, "There is insufficient evidence that xylitol syrup prevents caries in children under 2 years of age." [4] A conclusion of "insufficient" evidence does not mean that the intervention is ineffective, but rather that not enough evidence exists to support a recommendation.

Table 1. Summary of recommendations from American Dental Association expert panel for non fluoride caries preventive agents

Non fluoride agent	Recommendation	Strength of recommendation
Sucrose free polyol gum (sorbitol, xylitol)	Coronal caries: Children 5 years or older: chew gum for 10 to 20 minutes after meals. Adults: chew gum for 10 to 20 minutes after meals.	Weak* Expert opinionΔ
Sucrose free xylitol containing lozenges, candy, mint	Coronal caries: Children 5 years or older: dissolved slowly in mouth after meals (5-8 g/day divided into 2 to 3 doses)	Expert opinionΔ
Chlorhexidine/ thymol varnish	Root caries: elderly, adults; 1:1 mixture of chlorhexidine/ thymol varnish, applied every 3 months, reduces the incidence of root caries	Moderate certainty

*Evidence suggests intervention only after alternatives have been considered

ΔEvidence is lacking; any recommendation for or against based on expert opinion

Xylitol dentifrice

Two large scale RCTs comparing 10 per cent xylitol in fluoride dentifrice with fluoride dentifrices without xylitol were found. School age participants at high risk for caries were included. One trial was judged to be of fair quality and one poor. Since fluoride was included in the xylitol based dentifrice, the panel was unable to make a determination for or against the effect of xylitol in caries reduction when added to a dentifrice. The panel concluded, "There is insufficient evidence that xylitol in dentifrices prevents caries." [4]

Antibacterial agents (triclosan and iodine)

The panel found no published literature evaluating the effects of triclosan alone on caries prevention. Therefore, the panel concluded, "There is insufficient evidence that triclosan lowers incidence of caries."

Iodine reduces *Streptococcus mutans* concentrations in plaque biofilm and saliva. Four twelve month RCTs evaluated 10 percent povidone–iodine on coronal caries in pre school and school aged children. Three studies assessed caries using a visual examination. One study used laser fluorescence for diagnosis and reported quantitative laser fluorescence scores. Two studies were judged to be of fair quality and two studies of good quality. All studies were relatively small. Combining data was not possible because of differences in outcome measures reported in the studies. The panel concluded, "There is insufficient evidence that use of iodine lowers incidence of caries." [4]

Topical chlorhexidine (CHX) products

The panel found twenty-seven studies relating to various CHX products including combination products, varnishes, gels and rinses for anticaries effects. Table 2 summarizes the results of this review of twenty seven studies. A 10 percent CHX varnish is approved as a prescription drug by Health Canada "for the reduction of root caries in adults at high risk of dental caries".[8] An application for approval by the Food and Drug Administration in the USA has been submitted but no action has been taken at this time.

Calcium, phorphorous, casein derivative agents

Remineralization of demineralized enamel has been suggested to be enhanced by various calcium/ phosphorous products or casein derivatives.[10] The panel identified nine studies, eight of which were RCTs, evaluating various calcium and/or phosphate containing agents with and without casein derivatives. Two of these were judged to be of good quality; five were judged to be of fair quality and the others were deemed poor in quality. Comparison groups were varied, as were formulations such as dentifrice, rinses, and chewing gum. Both caries and white spot lesions were assessed in studies. Although the panel found several studies on calcium and phosphate agents with and without casein derivatives, the differences in composition of the products, their varying delivery mechanisms, differing study designs and the varied results made determination of efficacy for each agent difficult. The panel was unable to group them into an

Table 2: Topical chlorhexidine (*CHX*) products (27 studies)

CHX varnish			
6 RCTs (n=1300 subjects or pre school, school age and adolescent children)	Quality of RCTs Good=1 Fair=2 Poor=1. And 1 ongoing RCT may provide additional evidence	Meta analysis: Non significant difference of 10-40% between CHX and placebo varnish	Conclusion: Moderate certainty *In children aged 4 to 8 years, professionally applied 10 to 40 per cent chlorhexidine varnish does not reduce the incidence of coronal caries.*
CHX/Thymol varnish			
Coronal caries: 6 RCTs mainly of school age childrenwith high caries risk; 3 RCTs with varnish; 3 used 1:1 combination with sodium fluoride and compared with sodium fluoride control	Quality of RCTs Good=1 Poor=5		Conclusion: Low certainty *In children up to 15 years, application of a 1:1 mixture of chlorhexidine/thymol varnish does not reduce the incidence of coronal caries.*
Root caries: 4 RCTs with 1:1 combination of CHX/thymol varnish	Quality of RCTs Good=2 Fair=1. This also used sodium fluoride varnish compared to a fluoride varnish alone		Conclusion: Moderate certainty *In adults and elderly people, application of a 1:1 mixture of chlorhexidine/ thymol varnish reduces the incidence of root caries.*
CHX mouthrinses and gels			
Mouthrinses: 4 RCTs tested 0.12% CHX rinses in individuals of high caries risk	Quality of RCTs Good=1 Fair=3	Meta analysis, n+1200+ subjects showed a non significant difference between groups	Conclusion: High certainty *In children and adults, use of 0.05 to 0.12 percent chlorhexidine rinse does not reduce the incidence of coronal caries.*
Gels using 1% CHX: 7 clinical studies; no meta analysis	Quality of studies Fair=3 Poor=2	Limitations of studies -differences among studies -small numbers of study subjects -limited number of studies -inconsistency in results	Conclusions *In children aged 3-15 years, there is insufficient evidence that professionally applied 1 percent chlorhexidine gel reduces the incidence of caries.* *In adults and elderly, there is insufficient evidence that chlorhexidine gels reduce the incidence of root caries.between groups*

MA. The panel concluded, "There is insufficient evidence from clinical trials that use of agents containing calcium and/or phosphates with or without casein derivatives lowers incidence of either coronal or root caries."

Mother to child transmission of caries promoting factors

Four studies evaluated the use of caries preventive agents in mothers aimed at positively affecting the caries status of their children. One RCT evaluated xylitol gum and 40 percent CHX varnish compared to fluoride varnish; it reported that use of xylitol gum significantly lowered the incidence of caries in children. One RCT evaluated 10 percent CHX varnish and reported a non significant difference in caries increment while the other controlled trial evaluated 1 percent CHX gel and reported a statistically significant reduction in caries experience. The fourth study evaluated the reduction in caries with calcium supplementation in mothers and its effect on children. Authors reported a 27 percent reduction in risk of developing caries. Two studies were judged to be of fair quality while the other two were of poor quality. Based on these four trials which were conducted on different agents the panel concluded, "There is insufficient evidence that use of xylitol gum, chlorhexidine varnish or gel or calcium supplementation in mothers lowers incidence of caries in children." The panel noted that pregnant women were not included in any of the studies for non fluoridated products, so products have not been shown to be safe for this population.

CONCLUSION

The panel reported weak evidence for sucrose free polyol chewing gum to be recommended to parents and caregivers of children ≥5 years old for coronal caries prevention. Xylitol only gum or polyol combinations were recommended for children and should be chewed for 10 to 20 minutes, after meals. Expert opinion supported advising adults to chew polyol gum for caries prevention and also recommending for use of xylitol candy or hard lozenges in adults and children ≥5 years. If xylitol hard candy or mints is advised, the patient should be told to consume 5 to 8 grams divided into 2 or 3 doses each day. The panel found insufficient evidence to recommend xylitol syrup, xylitol in dentifrice, triclosan, iodine, sialogogues, and calcium phosphate/ACP or casein derivative products for caries prevention. None of the non fluoridated agents should be advised for use in pregnant mothers as agents have not been studied in this group.

Evidence was weak, however the in office application of 1:1 mixture of chlorhexidine/thymol varnish was recommended every three months for the reduction of root caries, but not for coronal caries. Other forms of CHX—0.5 to 1% CHX gel or CHX gel combined with fluoride— were not recommended for root caries prevention, and neither were 0.12 percent CHX rinses, alone or in combination with fluoride. No CHX product was recommended for coronal caries prevention.

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Oral health needs of Canadian prisoners as described by formerly incarcerated New Brunswickers

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ABSTRACT

Background: The oral health of prison populations in several countries has been shown to be compromised. However, little published research on Canadian prison populations is available. The purpose of this research paper is to determine whether such populations in Canada also suffer from compromised oral health. **Methods**: A convenience sample of forty-one formerly incarcerated individuals participated in the study in three New Brunswick urban centres. The study consisted of a questionnaire administered as a structured interview. **Results**: Reported risk factors included tobacco use (74% of respondents), type 2 diabetes (13%), drug or alcohol dependency (38%), and consumption of cariogenic foods and beverages (100%). One hundred per cent of the sample reported access to toothbrushes and dentifrice, while 42 per cent reported access to dental floss or floss picks. Seventy-six per cent reported toothbrushing frequency ≥ twice daily; 68 per cent reported "never" flossing. Fifty-four per cent reported having had dental treatment while incarcerated. The majority of the respondents (85%) expressed interest in a complimentary dental cleaning. **Discussion**: The findings were consistent with the results of studies from Australia and the UK. Dental hygienists may help prisoners meet their specific oral health needs, once these are properly identified through appropriate research such as clinical studies. **Conclusion:** Although the sample size of this study was limited, its findings imply that Canadian prison populations are likely to present with high oral health needs due to multiple risk factors. Correctional facilities may provide a novel environment for initiatives to improve oral hygiene self care modalities. Future clinical studies and surveys involving larger, multicentre samples of prison populations are indicated to assess accurately specific prisoner needs.

RESUMÉ

Contexte : La santé buccodentaire de la population carcérale s'avère compromise dans plusieurs pays, mais peu de publications en font état au Canada. Le présent article cherche donc à établir si la santé buccodentaire de ce type de population est aussi compromise dans notre pays. **Méthode :** Un échantillon de commodité de quarante-et-un anciens prisonniers de divers centres urbains du Nouveau-Brunswick a participé à l'étude qui comportait un questionnaire présenté sous forme d'entrevue structurée. **Résultats :** Les facteurs de risque mentionnés comprenaient le tabagisme (74% des répondants), le diabète de type 2 (13%), la dépendance à la drogue ou à l'alcool (38%) et la consommation d'aliments et de breuvages cariogènes (100%). Cent pour cent de l'échantillonnage a dit utiliser la brosse à dents et un dentifrice alors que 42 pour cent ont indiqué l'utilisation du fil ou de la soie dentaire. Soixante-seize pour cent ont dit se brosser les dents souvent, soit ≥ deux fois par jour; 68 pour cent n'ont jamais utilisé la soie dentaire. Quarante-quatre pour cent ont reçu un traitement dentaire pendant leur incarcération. La majorité des répondants (85%) se sont dit intéressés à recevoir un nettoyage dentaire gratuit. **Discussion :** Les données concordaient avec les résultats des études d'Australie et du Royaume-Uni. Les hygiénistes dentaires peuvent aider les prisonniers à satisfaire à leurs besoins particuliers de soins buccodentaires, lorsque ceux-ci sont correctement identifiés grâce à une recherche pertinente comme celle des études cliniques. **Conclusion :** Bien que l'échantillonnage de cette étude soit limité, les résultats laissent entendre que les populations des prisons canadiennes semblent présenter des besoins élevés en matière de santé buccodentaire, dus à plusieurs facteurs de risque. Les installations correctionnelles peuvent procurer un nouvel environnement pour les initiatives visant à améliorer les modalités de soins buccodentaires personnels. Il y a lieu de poursuivre d'autres études et sondages auprès de plus grands échantillonnages dans un plus grand nombre de centres d'incarcération, afin de répondre avec précision aux besoins particuliers des prisonniers.

Key words: oral health; health behaviour; public health; dental anxiety; tobacco; substance related disorders; dental health services

INTRODUCTION

Reports from the Correctional Service of Canada (CSC) indicate that approximately 13,000 individuals are incarcerated under its jurisdiction at any given time.[1] However, this represents only a fraction of adults incarcerated in Canadian correctional institutions—sixty-four per cent are in the custody of provincial and territorial, rather than CSC's federal institutions.[2] Overall, Canada's incarceration rate has been reported at 141/100,000 population.[2] The *Corrections and Conditional Release Act* mandates the provision of dental care to prisoners in federal facilities, and CSC's policies define dental care as an essential health service.[3,4] CSC reports state that a functioning dentition is considered a basic necessity for prisoners.[5] Inmates of institutions under CSC's jurisdiction may receive preventive and restorative care, in addition to emergency treatment,[6] while prisoners in provincial institutions may receive emergency treatment only (New

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Brunswick Director of Public Safety Institutional Services, 25 May 2011 [telephone interview]).

Walsh et al.[7] in a recent systematic review of research into dental health in prisons, noted increasing amounts of available relevant literature, citing studies from the USA, Europe, China, Australia, and South Africa; they did not reference any studies from Canada. CSC reports on inmates' health—based on Offender Intake Assessments (OIAs) available for over seventy per cent of the federally institutionalized population at the time of reporting—indicated that approximately fifteen per cent of federally incarcerated individuals were deemed to have "poor dental" health upon admission; both the magnitude and nature of dental problems were unspecified.[8,9] Bouchard[10] reported that over half of CSC inmates' OIAs indicated unmet financial needs upon admission. As reduced oral health outcomes and increased oral health needs are associated with low income Canadians,[11] and studies in the USA, the UK, and Australia have found prisoners to exhibit high prevalence of dental and periodontal disease and oral neglect,[12–18] it is suggested that specific oral health research is warranted for Canadian prison populations.

This student table clinic research paper shall determine whether it is likely that Canadian prison populations also suffer from compromised oral health based on assessment of concomitant risk factors as described by formerly incarcerated residents of the New Brunswick (NB) urban centres of Moncton, Fredericton, and Saint John. Secondarily, assessment of oral hygiene behaviours and attitudes will be used to provide implications for practice and recommendations for future research.

METHODS

Study Design

Quantitative methods were used in this descriptive study. The following paragraphs list the steps taken in the design of this study.

A literature review on the oral health status of Canadian prisoners was performed. Due to the scarcity of available publications from Canada, the search was expanded to include publications on the oral health status of inmates in correctional institutions throughout the USA, the UK, and Australia. In addition to these searches for publications, an inquiry regarding oral health measures surveys and data on usage of dental services was sent electronically via the CSC website contact form, and the NB Director of Public Safety Institutional Services was contacted regarding usage of dental services by inmates within NB provincial correctional institutions. The responses from the Nursing Project Manager with CSC Health Services (2011, March 14 [email correspondence]) and from the NB Director of Public Safety Institutional Services (2011, May 25 [telephone interview]) both indicated that the requested data were unavailable.

The lack of published and unpublished data required the authors to collect original data on Canadian prisoners' oral health needs. Questionnaires consisting of twenty items were used to expedite data collection for this preliminary study.

As a result of time restrictions and due process within government administered institutions, the authors were unable to survey incarcerated individuals serving their time. Therefore, the information obtained in this study regarding prisoners' oral health habits and oral health risks is limited to retrospective accounts from a sample of previously incarcerated persons.

Questionnaires were administered verbally as structured interviews by both of the authors primarily to overcome potential literacy issues, documented in CSC populations.[19] A similar methodology was employed by Heidari et al.[12] The authors of this study also supported the method of conducting personal interviews to establish rapport, increase response rate, and ensure greater confidence in response validity.

Upon receiving approval from the Oulton College Ethics Committee, a pilot study of six questionnaires was conducted at Community Chaplaincy For Ex-Offenders, Moncton. Following this pilot study, minor alterations to the questionnaire were made. The pilot questionnaires were included in the final calculations to increase sample size, as the content of the questionnaire was essentially unchanged. Amendments to the questionnaire (see Supplementary information) were as follows:

- The question regarding date, institution, and length of incarceration was streamlined to expedite data collection; it provided multiple Atlantic region institutions as check box options, as well as an option to write in unlisted institutions. The same format was applied to the question regarding what dental services were accessed while incarcerated.
- Negative responses were added to check box lists, for example, "none of the above" or "never".
- Wording for the Likert scale of 1 to 5 used to evaluate attitudes towards dental services was simplified, for example, from "very poor" to "strongly disagree". The question regarding access to dental care after release was similarly simplified.
- One question was omitted following the pilot; and its data omitted from the results.

Two of the completed questionnaires were omitted from the results, bringing sample size down to thirty-nine. The respective respondents made it clear to the interviewers that many of their responses were fabricated; thus their validity was deemed unfavourable.

Descriptive statistical analysis was performed as appropriate, including means, standard deviations, ranges, and frequency distribution charts (both actual and relative). Responses from the thirty-nine questionnaires were used in the analysis.

Sample

A convenience sample was employed during the timeframe of 11–25 April 2011, using several facilities in the NB urban centres of Moncton, Fredericton, and Saint John as data collection sites. A questionnaire was administered to forty-one formerly incarcerated individuals (39 male and 2 female) at the following sites: Community Chaplaincy For Ex-Offenders, Moncton; John Howard Society, Moncton; YMCA ReConnect Street Intervention Program, Moncton; Saint John Community Chaplaincy; and Fredericton Community Kitchen. Individuals were invited verbally to participate, and all participants signed consent forms. In Moncton, participation was encouraged by entering participants into draws for a free dental cleaning at Oulton College Dental Hygiene Clinic and a gift certificate. Participants in Fredericton and Saint John were not entered into the draws due to geographic separation from Oulton College in Moncton. These participants were instead offered free toothbrushes as an incentive. Names for the draws and consent forms were collected independently of questionnaire responses in order to ensure anonymity of respondents.

The only inclusion criterion required of respondents was prior incarceration. However, two questionnaires were later excluded due to lack of confidence in response validity. Ninety-five per cent of the included questionnaires' respondents were male and five per cent were female. The mean age of all respondents was 43 (±12) years; ranging from 22 to 70 years. The majority of respondents (72%) reported incarceration within provincially operated Atlantic region facilities—all but four of whom reported spending time in NB provincial institutions; 46% within federally operated Atlantic region facilities; 26% within Canadian facilities outside of the Atlantic region; and 5% within facilities in the USA. Cumulative lengths of incarceration ranged from 1 month to 272 months, with a mean of 45 (±53) months. The mean cumulative length of incarceration is based on 38 figures, as this information was omitted by one respondent.

Bias and limitations

The authors identified several limitations of this study and contributors to bias in the research design that should be taken into consideration:

- Face to face interviews may have influenced the respondents' answers. Though it is believed that this method of questionnaire administration contributed to an overall higher degree of validity, the respondents may have been reluctant to answer sensitive questions honestly or may have provided answers that they believed would please the interviewers.
- The limited number of female respondents should also be taken into consideration as a source of bias.
- The interviewers were unable to survey participants during their sentences in prison. This may have affected the results, as there could have been changes in products available, such as foods and beverages or oral hygiene implements, since the respondents' release. Changes in prison policies may also have occurred.
- The time lapse between the respondents' incarcerations and questionnaire responses varied, leading to a potential inability of some respondents to recollect accurately details and attitudes pertaining to their time spent in prison.
- Most notably, the facilities selected for questionnaire administration serve a small population of ex-offenders, most of whom voluntarily access these services. The convenience sample included only one individual who was not utilizing the services of these facilities. As such, the sample may not be highly representative of the entire population of formerly incarcerated individuals, and is unlikely to be generalizable.

Challenges researching in prison systems

Challenges conducting research in prison facilities have been documented in other countries. Problems cited include prisoner release and transfer between institutions, security clearance, adequate prison staffing, and prisoners' lack of interest in study participation.[12,13,20] This study encountered similar challenges in gaining access to the prison population.

RESULTS AND DISCUSSION

Owing to a lack of existing data from NB provincial institutions, this study's data were compared only to data from CSC's federal institutions and from other countries.

Sample

The sample exhibited similar gender ratios to CSC's incarcerated offender population (about 4% of federally incarcerated individuals are women). The ages of the study sample were generally older than CSC's incarcerated offender population.[1] This may be related to the fact that respondents had already been released from prison. Prisoners within provincial institutions may be considered short term (having sentences under two years) or remand prisoners (those awaiting trial), whereas federal prisoners typically serve longer sentences (NB Director of Public Safety Institutional Services, 2011 May 25 [telephone interview]).[2]

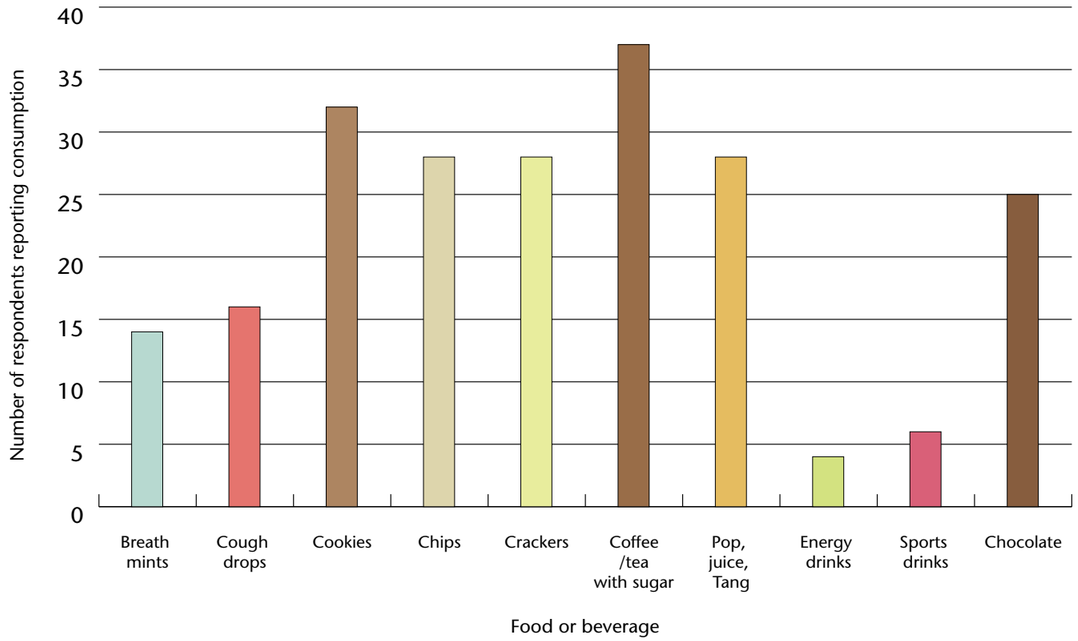
Risk factors and disease

Thirteen per cent of the respondents (5/39) reported having type 2 diabetes, 8 per cent (3/39) frequent vomiting, and 3 per cent (1/39) sexually transmitted infections (STIs) while incarcerated. Seventy-four per cent (29/39) reported tobacco use while incarcerated. Thirty-eight per cent (15/39) reported drug or alcohol dependency while in prison. Figure 1 illustrates reported cariogenic food and beverage consumption while in prison. While several of this study's respondents stated verbally that energy drinks were not available to prisoners, all of the study sample reported consumption of at least one listed type of cariogenic food or beverage, with hot beverages containing sugar (95%) and cookies (82%) being reported by the highest percentages of respondents. Data on frequency of cariogenic diet were not collected. This study's data on prevalence of risk factors and diseases generally reflect data available on CSC's inmate population.

CSC data found that male inmates are 40 per cent more likely to be treated for diabetes than similarly aged Canadian males.[10] The prevalence of diabetes in Canadian males aged 20 years and higher has been reported to be 8.5 per cent.[21] This differs from the findings of international studies; Heidari et al.[12] reported similar prevalence of diabetes between their sample and the general population in the UK.

CSC data indicated that 72 per cent of inmates surveyed

Figure 1: Consumption of listed cariogenic foods and beverages reported by the sample population (N=39).



in 1995 reported tobacco use, which is over twice the expected prevalence based on Canadian males of similar ages.[10] Heidari et al. also found self reports of tobacco use similar to this study—78 per cent prevalence for an average of fifteen years.[12]

The data obtained from this study's reports of sexually transmitted infections (STIs) are unlikely to reflect accurately the health status of the sample, partially due to the vague nature of the term "STI" and the lack of a clearly communicated definition during the interviews. It is recommended that future studies adopt CSC's Infectious Disease Surveillance System definition (documenting HIV and HCV independently of STIs)[22] and communicate a specific definition of the term "STI" to respondents.

This study indicated high prevalence of drug or alcohol dependence while incarcerated; this finding may still underestimate actual prevalence. The prevalence of drug or alcohol abuse at intake among CSC prisoners has been found to approximate 70 per cent.[10] Illicit drug use, without indication of dependency, was reported by 83 per cent in the sample of Heidari et al.[12] CSC data state that 11 per cent of inmates reported injecting drugs since being admitted into custody.[23] Collection of data on drug and alcohol use within prisons may be confounded by the illicit nature of these activities; for example, prisoners may be unwilling to report drug use when surveyed.

Prisoners' access to cariogenic foods and beverages has been noted in the USA and the UK.[12,16] It is recommended that future studies consider frequency of cariogenic diet as well as overall nutritional value of cariogenic foods.

Oral hygiene habits and denture use

Questions regarding respondents' access to oral hygiene supplies and their toothbrushing and flossing habits were not answered by one respondent; therefore, the statistics regarding oral hygiene habits are based on only thirty-eight respondents' reports. All other statistics are based on thirty-nine included responses. One hundred per cent (38/38) of the respondents reported having access to a toothbrush, all (38/38) to dentifrice, and 42 per cent (16/38) to dental floss or floss picks while incarcerated. Seventy-six per cent (29/38) of respondents reported toothbrushing frequency greater than or equal to twice daily, and 11 per cent (4/38) reported frequency less than once per day while incarcerated. However, 68 per cent (26/38) reported never using interdental aids, and only 16 per cent (6/38) reported frequency of using an interdental aid greater than or equal to once daily while incarcerated. An interesting discovery was that boredom was cited informally as a factor contributing to increased toothbrushing frequency by a small number of respondents of this study. Twenty-six per cent (10/39) of the respondents reported having dentures while in prison. Of these, 50 per cent (5/10) reported never removing them.

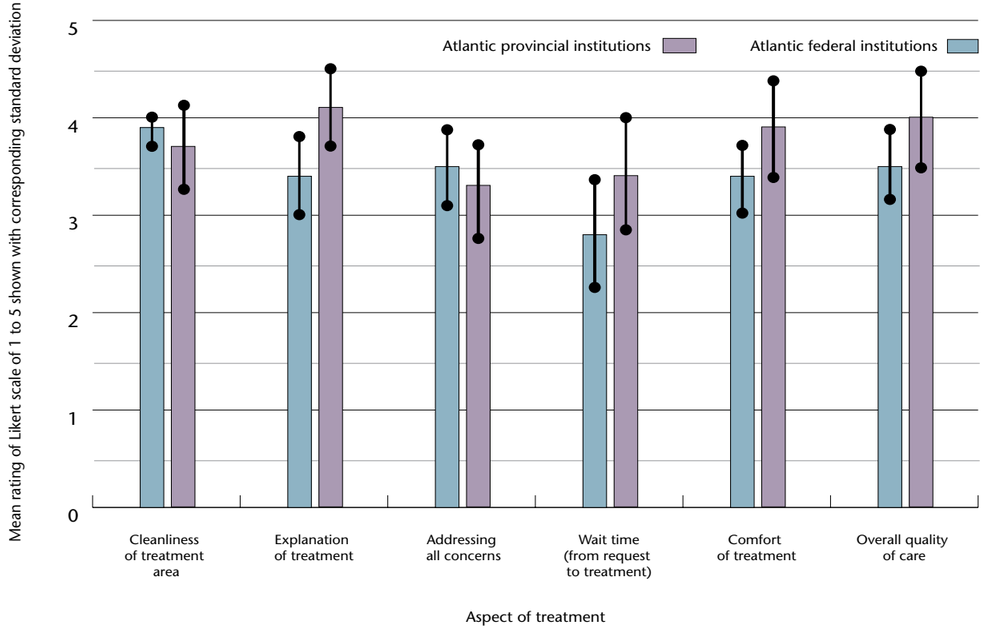
The comparatively low numbers of respondents reporting access to dental floss may reflect the policies of correctional facilities. Dental floss is reported to be available in CSC prison canteens;[10] however, it is not permitted within NB provincial correctional facilities, as it may be used as a weapon. NB provincial prisoners are supplied with dentifrice and special correctional facility toothbrushes having shorter and more flexible handles to prevent their use in the fabrication of weapons (NB Director of Public Safety Institutional Services, 2011 May 25 [telephone interview]). Restriction of oral hygiene implements has been a recurrent theme in the literature, reported in the USA, the UK, and Australia.[13,24,25]

The reported toothbrushing frequencies were similar to reported frequencies for the general population.[11] Similar findings were noted in the UK—77 per cent of a sample of prisoners at Her Majesty's Prison (HMP) Leeds, HMP Wealstun, and Wetherby Young Offenders' Institution, and 70 per cent of a sample at HMP Brixton reported brushing twice per day.[12,26] However, it should be noted that the same HMP Brixton sample population was also found to exhibit high plaque levels, decayed/ missing/ filled tooth index (DMFT) scores, and periodontal disease prevalence. A study in Australia also recorded self reports of high toothbrushing frequency—50 per cent of respondents brushing twice in one day—with high DMFT scores and higher extraction rates than the general Australian population.[13] The authors of the study at HMP Brixton do not discuss possible reasons for the discrepancy between reported toothbrushing frequency and dental biofilm control; it may be that prisoners have poor toothbrushing technique, did not respond truthfully to the examiners' questionnaire, or have high exposure to cariogenic diet between toothbrushing. These findings illustrate the need for clinical research within Canadian correctional facilities.

Attitudes towards dental services

Twenty-three per cent (9/39) of the respondents reported having dental fear or anxiety. Thirty-three per cent (13/39) of the respondents felt that their access to dental care had improved since release, 23 per cent (9/39) felt that it had deteriorated and 44 per cent (17/39) felt that it had remained the same. Eighty-five per cent (33/39) of the respondents expressed interest in a complimentary dental cleaning. Fifty-four per cent (21/39) of the respondents reported having had dental treatment while in prison. Of these, 62 per cent (13/21) reported accessing treatment in federally operated Atlantic region facilities, 33 per cent (7/21) in provincially operated Atlantic region facilities, and 14 per cent (3/21) in other Canadian or American facilities. Twenty-four per cent (5/21) of respondents—reporting use of dental services while incarcerated—received dental cleanings, 67 per cent (14/21) extractions, 24 per cent (5/21) fillings or root canal treatment, 19 per cent (4/21) denture fittings, and 10 per cent (2/21) dental exams. Figure 2 compares the attitudes

Figure 2: Attitudes towards provided dental services of respondents accessing dental services while incarcerated in federally- (N=15) and provincially-administered (N=8) institutions within Atlantic Canada.



towards these dental services conveyed by respondents who reported accessing dental services while incarcerated at federally administered and provincially administered correctional facilities within Atlantic Canada. Eighty-six per cent (18/21) of the respondents who reported dental treatment while incarcerated reported having dental services paid for by prison coverage, 10 per cent (2/21) by Ministry of Indian Affairs and Northern Development, and 14 per cent (3/21) by social services.

This study found that extraction was the most frequently reported service accessed at respondents' most recent dental visits, as well as at their dental visits while incarcerated. This may reflect on the policies of the correctional institutions. Inmates in New Brunswick provincial institutions receive only emergency treatment (New Brunswick Director of Public Safety Institutional Services, 2011 May 25 [telephone interview]). Published literature indicated that remand prisoners in Australia also typically receive only emergency dental treatment.[13]

The percentage of respondents of this study reporting dental fear or anxiety was low compared to findings by Heidari et al.[12] at HMP Brixton—49 per cent of their sample reported the same.[12] However, by Canadian standards, it may in fact be somewhat high: a recent survey of 1101 Canadians indicated that 15.3 per cent of the general adult population is expected to be at least somewhat afraid of the dentist.[27]

The results of the present study did not indicate clearly whether former prisoners' access to dental services was perceived to be greater while in prison or since release; however, CSC data suggest that federally incarcerated individuals visit the dentist more frequently than comparably aged Canadians.[10] Several of the respondents of this study indicated informally that they had not made the effort to seek treatment since release. This self reported lack of motivation may relate to findings from:

- the *Oral Health Component of the Canadian Health Measures Survey,* which indicated that lower income Canadians experience diminished use of professional dental services and have increased dental treatment needs when compared to those with higher incomes,[11] and
- to the findings of Heidari et al. that prisoners made more use of elective dental services while in prison than outside. Their respondents generally rated their oral health as poor and thought they needed treatment (71%).[12]

This self assessment of need is similar to that of the respondents of this study—85% of whom exhibited interest in a free dental cleaning—and is in contrast to findings of the Osborn et al.[12] study that prisoner self perception of need for a dental cleaning was low (8.2% among males and 10.6% among females). However, only 13 per cent (5/39) of this study's respondents reported having a dental cleaning while incarcerated. Again, this may be related to policies of the correctional institutions.

Significance of findings to Dental Hygiene

Osborn et al. suggested,[13] "Prisons represent an important public health opportunity to improve the health status of prisoners, including oral health. The incarceration period is an ideal opportunity to educate this group in good oral health care practices and provide the necessary treatment." Other recommendations in the literature include the establishment of structured oral hygiene and diet counselling programs to decrease dental decay among prisoners[12,16] and additional periodontists and dental hygienists in the prison system based on treatment needs.[18]

Numerous strategies have been explored to provide dental services to prisoners. Tactics employed in the American facilities include permanent staffing by US Public Health Service dentists,[16] private contractors,[16,28–30] partnerships between academic institutions and prisons to provide dental and dental hygiene services,[16,25,28,31,32] and employing prisoners themselves as dental assistants.[16,33]

In Canada, arrangements for dental treatment have involved salaried part time dental staff, prisoners trained to fabricate dentures, and services provided by local dentists (New Brunswick Director of Public Safety Institutional Services, 2011 May 25 [telephone interview]).[34] Specific data on employment in prison settings were unavailable for Canadian dental hygienists; 0.3 per cent of dental hygienists in the USA reported a prison environment as a primary workplace, and 0.4 per cent as a secondary workplace.[35,36]

The legal mandate for dental services in Canadian correctional facilities could provide increased opportunities for dental hygienists to provide oral health promotion and oral hygiene education services, as well as clinical services, to a population with multiple oral health risk factors. There may also be partnerships formed with private sector corporations or educational institutions for which hygienists could act as administrators.

CONCLUSION

Summary of findings

While the study sample size was limited, this study's findings imply that Canadian prison populations are likely to present with high oral health needs due to multiple risk factors. Correctional facilities may provide a novel environment for initiatives to improve oral hygiene self care modalities, as prisoner motivation to perform these habits is indicated to be advantageous.

Recommendations for future research

The oral health status of Canadian prisoners must be determined via clinical research within institutions, preferably in larger, multicentre studies. Other important facets to consider are the efficacy of current dental interventions, prisoner access to oral hygiene implements, and the potential benefits of an oral hygiene education program within correctional facilities.

Recommendations for optimal methodology have been made in the literature. Research initiatives could capitalize on routine prisoner screenings to provide more comprehensive oral health data.[7,12] Walsh et al.[7] recommend prospective studies rather than retrospective analyses of chart records. Longitudinal and intervention studies are recommended in Canadian institutions to determine the efficacy of prison dental services. These recommendations are in accordance with those of Walsh et al.[7] in the UK, and Mixson et al. and Salive et al. in the USA.[16,17] Based on the findings of American and Australian studies, oral health of prisoners may vary by gender[13] and by ethnicity.[16–18] Future research should attempt to determine whether similar patterns prevail in Canadian institutions. Furthermore, research should distinguish between institution types. This study's findings showed that available dental services and oral hygiene implements vary by institution type—comparing different prison types was also recommended by Salive et al.[17] Finally, according to Boyer et al.,[15] studies conducted on Canadian prison populations should follow a standardized, transparent methodology to facilitate comparison of data sets.

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- Fredericton Community Kitchen, Fredericton, NB
- Saint John Community Chaplaincy, Saint John, NB

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Supplementary information

The revised questionnaire *Oral Health Needs of Formerly Incarcerated New Brunswickers* is available with the online version of this article (www.cdha.ca/onlinejournal/Suplementary_Information.pdf) or it may be requested from the corresponding author.

Conflict of Interest

The authors declare no conflicts of interest.

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RESEARCH CORNER

Dental digital radiography

The introduction of dental digital radiography has provided expanded opportunities for the use of computer aided diagnostic tools in dental healthcare. What was once an expensive and rare piece of technology is now commonplace in private practice. But do advanced technologies translate to improved client care? How has progression in digital technology affected treatment modalities, client health, and requisite skill upgrades for dental hygienists?

The following titles of peer reviewed articles were selected from a PubMed search using the terms "dental digital radiography", "mandibular x-ray", "dental hygiene", "oral hygiene", "periodontology" and "computer aided diagnostics". They explore the questions we asked that might capture your reading interest as a key player in the oral health profession. Links to the articles follow the titles; not all links open to full articles especially those published recently, and you may have to use resources from your universities or employers to access the full article in the pursuit of continuing professional development (CPS).

Take your CPD to the next level; have you further discussion on reading these articles? Please email your comments to journal@cdha.ca as a "letter to the editor" for consideration in the journal.

1. Digital imaging in dentistry
Essen SD.
Todays FDA. 2011 Sep–Oct;23(6):62–68.
http://www.ncbi.nlm.nih.gov/pubmed/22132658

2. Facilities update: new spaces, new technologies
Adams B.
Penn Dent J (Phila). 2010 Fall:10–12.
http://www.ncbi.nlm.nih.gov/pubmed/21941873

3. Teledentistry-assisted, affiliated practice for dental hygienists: an innovative oral health workforce model
Summerfelt FF.
J Dent Educ. 2011 Jun;75(6):733–42
http://www.ncbi.nlm.nih.gov/pubmed/21642518

4. Panoramic radiography: digital technology fosters efficiency
Benson BW, Liang H, Flint DJ.
Compend Contin Educ Dent. 2011 Nov–Dec;32 Spec No 4:6–8.
http://www.ncbi.nlm.nih.gov/pubmed/22195340

5. Intraoral digital radiology: a safe, cost-efficient imaging solution
Levato CM.
Compend Contin Educ Dent. 2011 Nov–Dec;32 Spec No 4:48–50.
http://www.ncbi.nlm.nih.gov/pubmed/22195351

6. Utility and effectiveness of computer-aided diagnosis of dental caries
Tracy KD, Dykstra BA, Gakenheimer DC, Scheetz JP, Lacina S, Scarfe WC, Farman AG.
Gen Dent. 2011 Mar–Apr;59(2):136–44.
http://www.ncbi.nlm.nih.gov/pubmed/21903524

7. Computers—they're ubiquitous!
Benz C.
Int J Comput Dent. 2011;14(2):87–88.
http://www.ncbi.nlm.nih.gov/pubmed/21877374

8. Is the current generation of technology facilitating better dentistry?
Christensen GJ.
J Am Dent Assoc. 2011 Aug;142(8):959–63.
http://www.ncbi.nlm.nih.gov/pubmed/21804064

9. Comparative dental radiographic identification using flat panel CT
Birngruber CG, Obert M, Ramsthaler F, Kreutz K, Verhoff MA.
Forensic Sci Int. 2011 Jun 15;209(1–3):e31–4. Epub 2011 May 17.
http://www.ncbi.nlm.nih.gov/pubmed/21592696

10. Electronic dental records: start taking the steps.
Bergoff J.
Dent Assist. 2011 Mar–Apr;80(2):18–20, 22–23, 26–28; quiz 30, 32–33.
http://www.ncbi.nlm.nih.gov/pubmed/21568218

11. Enterprise-wide implementation of digital radiography in oral and maxillofacial imaging: The University of Florida dentistry system
Nair MK, Pettigrew JC, Jr., Loomis JS, Bates RE, Kostewicz S, Robinson B, Sweitzer J, Dolan TA
J Digit Imaging. 2009 June;22(3):232–241.
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3043692/?tool=pmcentrez

Comparison of Er:YAG laser debridement versus conventional scaling and root planing

Erica R. Zammit, RDH, BDSc(DH)

ABSTRACT

Objective: Although scaling and root planing (SRP) with manual and ultrasonic scalers is the traditional approach for non surgical periodontal therapy, limitations related to difficulty in accessing furcations, grooves, and deep pockets have led to the exploration of other therapeutic modalities. The aim of this review was to investigate whether the Er:YAG laser is more efficacious than conventional SRP in the treatment of chronic periodontitis. **Method:** Electronic database searches of EBSCOhost, PubMed, and the Cochrane Central Register of Controlled Trials (CENTRAL) were performed, identifying articles from 2000 through to end of search on June 30, 2011. A total of 61 papers were identified, of which six met review criteria. **Results:** Five randomized controlled clinical trials and one meta analysis were retrieved. Results for periodontal pocket depth reduction and clinical attachment level gain varied in significant difference between the two treatment groups. Only one study found significant differences between the two modalities of treatments of gingival recession and bleeding on probing, while none of the studies found a significant difference among treatment modalities for plaque and gingival index level changes. Microbiological analysis of subgingival plaque indicated significant differences with specific bacteria; however, each study used a different method of analysis, which made comparison difficult. **Conclusion:** The available data indicate that both the Er:YAG laser and conventional SRP are effective for periodontal therapy; yet the data were inconclusive in demonstrating that the Er:YAG laser is more efficacious than conventional SRP.

RESUMÉ

Objet : Bien que le détartrage et le surfaçage avec détracteurs manuels ou ultrasoniques constituent le mode traditionnel de thérapie parodontale non chirurgicale, les limites associées à la difficulté d'accès à la furcation, aux sillons et aux poches parodontales profondes ont mené à l'exploration d'autres modalités thérapeutiques Cette revue a pour objet d'investiguer si le laser Er:YAG est plus efficace que le détartrage et le surfaçage conventionnels pour le traitement de la parodontie chronique. **Méthode :** Des recherches effectuées dans les bases de données électroniques EBSCOhost, PubMed et le Registre central des essais contrôlés Cochrane (CENTRAL) ont permis d'identifier 61 articles à partir de l'an 2000 jusqu'à la fin des recherches, le 30 juin 2011. Parmi eux, six répondaient aux critères de l'étude. **Résultats :** Cinq essais contrôlés randomisés et une méta-analyse ont été récupérés. Les résultats, concernant la réduction de la profondeur des poches parodontales et le niveau de gain d'attache clinique, variaient considérablement entre les deux modalités de traitement, celui de la récession gingivale et celui du saignement lors de l'examen, alors qu'aucune des études n'a trouvé de différence significative dans les modalités de traitement de la plaque et le niveau des changements de l'index gingival. L'analyse microbiologique des plaques sous-gingivales a indiqué d'importantes différences bactériennes particulières; toutefois, chaque étude a utilisé diverses méthodes d'analyse, ce qui a rendu la comparaison difficile. **Conclusion :** Les données disponibles indiquent que les deux méthodes, le laser Er:YAG et le détartrage et surfaçage conventionnels sont efficaces comme thérapie parodontale; néanmoins, les données n'étaient pas concluantes pour démontrer si le laser Er:YAG était plus efficace que la méthode traditionnelle de détartrage et surfaçage.

Key words: laser; Er:YAG; periodontal therapy; chronic periodontitis; scaling and root planing; debridement

OBJECTIVE

With increased use of lasers in cosmetic dentistry over the past two decades, clinicians and researchers have considered the use of lasers for periodontal therapy. The ability of the erbium:yttrium-aluminum-garnet (Er:YAG) laser to prevent thermal damage while performing hard tissue ablation makes this laser an ideal tool for periodontal debridement.[1] In vitro studies have demonstrated the effectiveness of the Er:YAG laser in removing subgingival calculus.[2,3] The conventional instruments for periodontal debridement, manual and ultrasonic scalers, have difficulty reaching furcations, grooves, and deeper root surfaces.[4] Clinically, the Er:YAG laser has been shown to reach areas that are difficult to access without causing trauma, making it an alternative instrument for debridement.[4] It is thought that the beneficial effects of the Er:YAG laser rest in its ability to access intricate anatomical areas along with its bactericidal function.[4,5]

Although studies have shown that the Er:YAG laser is safe and functional for periodontal debridement, an evidence based decision to use this laser as an alternative to conventional therapeutic modalities must consider efficacy in relation to clinical outcomes. Much of the early research on the Er:YAG laser was performed through

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{This article was submitted to peer review when the author was a student in the Dental Hygiene program at the University of British Columbia. The author has since successfully obtained her degree, and is a professor in Faculty of Dental Hygiene at George Brown College, Toronto. This issue presents the last of the peer reviewed papers accepted in the Student Corner category. The Student Corner will not appear in the journal hereafter.}

in vitro studies and did not allow for the evaluation of clinical outcomes.[1] Over the last decade, researchers have performed randomized controlled clinical trials to investigate the clinical effects of the Er:YAG laser as a periodontal therapeutic modality. The purpose of this review was to address the following focused question: When considering periodontal therapy for clients with chronic periodontitis (periodontal pocket depth ≥ 4mm), is the use of the Er:YAG laser more efficacious than conventional scaling and root planing (SRP)? Variables analyzed included pocket depth (PD), clinical attachment level (CAL), gingival recession (GR), bleeding on probing (BOP), plaque index (PI), gingival index (GI) and microbiological analysis (MA).

METHODS

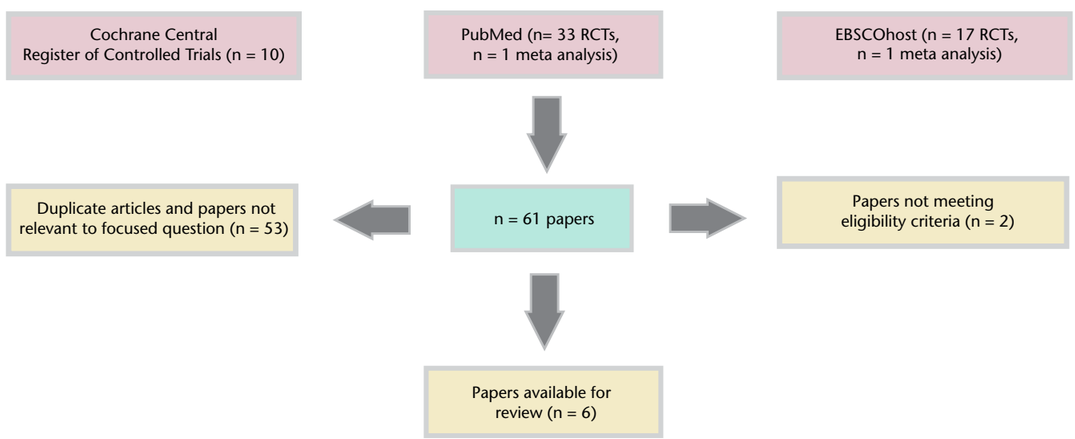
The electronic databases, EBSCOhost, PubMed, and the Cochrane Central Register of Controlled Trials (CENTRAL), were searched for primary literature on the use of the Er:YAG laser in periodontal therapy. The search identified articles from 2000 through until 30 June 2011, and was conducted using the key words of laser, Er:YAG, periodontal therapy, chronic periodontitis, scaling and root planing, and debridement.

The inclusion criteria chosen for selection of studies included meta analyses and randomized clinical trials that involved only human subjects, and that were single or double blinded and peer reviewed. In vitro studies, animal trials, case studies and literature reviews without meta analysis were excluded from the review. Additionally, the selected studies compared the Er:YAG laser with manual or ultrasonic SRP alone and involved subjects with chronic periodontitis around natural dentition, where periodontal pockets were ≥4mm. Clinical parameters required for study selection were periodontal pocket depth, clinical attachment levels, gingival recession, bleeding on probing, plaque index, gingival index and microbiological data.

RESULTS

The search strategy resulted in sixty-one potential papers based on titles with abstracts (Figure 1). Papers not relevant to the focused question and duplicate papers were removed, resulting in eight papers for full text examination.[6–13] Upon examination, two papers did not meet the eligibility criteria,[12,13] one paper included a systematic review without meta analysis,[12] and the other explored all of the pertinent clinical parameters, without comparison of the Er:YAG laser with manual or ultrasonic SRP alone.[13] The six papers included in the review consisted of five split mouth randomized clinical trials and one meta analysis.

Figure 1: Number of papers found in search



DISCUSSION

Periodontal Pocket Depth (PD)

Six studies examined pocket depth and indicated that both SRP and Er:YAG laser treatment resulted in significant differences in pocket depth reduction.[6–11] However, the results varied in significant difference between the two treatment groups for PD reduction:

- no significant difference between groups at one, three, six and twelve months after treatment,[6]
- no significant difference between groups at three and six months after treatment,[7]
- a significant difference between groups at three months, and at one and two years after treatment; the SRP group showed PD reduction at three months but with little improvement thereafter, whereas the Er:YAG laser group continued to show improvement in PD for up to two years, with pocket reduction being more significant in PD≥7mm,[8]
- significant difference between groups at one and two years after treatment with PD≥7mm showing the greatest change,[9]
- Er:YAG laser group had significantly better PD reduction at one month after treatment, but at four months after treatment there was no further improvement in the laser group and no significant differences between groups,[10] and
- a reduction in PD for both treatment groups, but with no significant difference between treatment groups at six and twelve months after treatment.[11]

The differences in findings among studies for pocket depth reduction could be related to variation in the mean initial pocket depth. As well, only two of the studies divided the periodontal pockets into sub groups according to depth to allow for comparison of pocket depth reduction to initial pocket depth.[8,9] These studies found that there was a greater probability of PD reduction with pockets that were deeper at baseline.[8,9] Since the results for pocket depth reduction varied, future studies need to analyze this clinical outcome in detail and remove confounding factors.

Gingival Recession (GR)

Similar to PD reduction, six of the studies indicated that both the SRP and Er:YAG laser treatment groups led to significant CAL gain but with varied results in significant difference between treatment groups.[6] A summary of results of the studies for changes in CAL is as follows:

- no significant difference between the two treatment groups for all time periods,[6]
- no significant difference in CAL gain between the two groups at three and six months after treatment,[7]
- significant difference in CAL gain between the two groups at one month after treatment only,[10]
- significant difference in CAL gain between the two groups where PD≥5mm for all time periods; the SRP group did not have significant CAL gain after three months whereas the Er:YAG laser group continued to show improvement up to two years after treatment,[8]
- Er:YAG laser group had significantly more CAL gain than the SRP group at one and two years after treatment, with sites of deeper pocket depth having more CAL gain,[9] and
- no significant differences between groups at six and twelve months after treatment.[11]

The variance in findings among studies for changes in CAL could be related to a difference in the mean initial pocket depth, similar to the findings for pocket depth reduction.

Bleeding on Probing (BOP)

Similar to the results for gingival recession, three studies found that while both treatments were capable of reducing BOP, there was no significant difference between the two treatment groups,[6,7,10] while one study did find a significant difference between the two groups.[9] The findings of the studies for changes in BOP were as follows:

- a significant reduction in BOP within groups for all time periods but the comparison of results between groups was not clearly documented,[6]
- results for changes in BOP were similar at three and six months for both groups,[7]
- both treatments were capable of significantly reducing BOP as measured at one and four months after treatment, but without significant differences between groups,[10] and
- both groups displayed a significant reduction in BOP at one and two years after treatment, but the Er:YAG laser group had a more significant reduction in comparison to the SRP group.[9]

Plaque Index (PI)

Five studies measured plaque index levels and found no significant difference in plaque reduction between the SRP and Er:YAG laser groups in PI:[6–10]

- a significant reduction in PI levels for both groups at three, six and twelve months after treatment, with no significant difference between groups,[6]
- PI reduction was similar for both groups at three and six months after treatment,[7]
- no significant difference within or between the SRP and Er:YAG laser groups for all time periods,[8]
- no significant difference between or within groups for PI levels at one and four months after treatment,[10] and
- no significant difference between or within groups at one and two years after treatment.[9]

Gingival Index (GI)

Three studies investigated gingival index levels as a clinical outcome and found no significant difference between the two treatments.[6,8,9] The following data lists the results of the studies related to changes in gingival index:

- a significant reduction in GI levels at three, six and twelve months after treatment for the SRP group only with no significant difference between the two groups,[6]
- significant differences within each group at three months and one year after treatment; with no significant difference between groups at any time period,[8] and
- significant differences within groups at one and two years after treatment with no significant difference in GI levels between the SRP and Er:YAG laser group.[9]

Microbiological Analysis (MA)

Three studies performed microbiological analysis on subgingival plaque samples,[6,9,10] and the results were:

- the Er:YAG laser group had a significant reduction in: *Aggregatibacter actinomycetemcomitans (Aa)* at twelve days and one, six and twelve months; *Porphyromonas gingivalis (Pg)* at twelve days and one, three and twelve months and *Prevotella nigrescens (Pn)* and *Tannerella forsythia (Tf)* at twelve days and one month

after treatment.[6] However, this same study found that the only significant reduction for the SRP group was for *Aa* and *Tf* at twelve days and one month after treatment.[6] Furthermore, this study found the Er:YAG laser group had a significant reduction in comparison to the SRP group for *Aa* at twelve days, *Pg* at one and three months, and for *Ag* and *Pg* at twelve months after treatment,[6]

- both treatments led to a reduction in *Aa, Pg, Pn, Tf* and *Prevotella intermedia* at two days and one month after treatment with no significant difference between the two treatments,[10] and
- bacteria were classified into groups; both the SRP and Er:YAG laser groups had a significant reduction in cocci, non motile rods and spirochetes at one and two years after treatment with no significant differences between groups.[9]

The microbiological data in these studies focused on different types of bacteria and utilized different techniques for analysis, which may explain the difference in results across studies. Future studies need to analyze microbiological data with further detail and consistency.

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CONCLUSION

All investigated studies determined that the Er:YAG laser is effective as a periodontal monotherapy. However, the findings were inconclusive as to whether the Er:YAG laser alone is more efficacious than conventional scaling and root planing.[6–11] Further well designed studies with sample size calculations and long term follow up are needed before a conclusive decision is reached on the efficacy of using the Er:YAG laser as an alternative to conventional scaling and root planing. Variables related to differences in laser use, such as energy settings, fibre tip diameters, tip inclination angle and application time need to be considered along with study participants' smoking habits. Effective dental hygiene practice relies on evidence based decisions in choosing appropriate methods for periodontal therapy, with the Er:YAG laser being another option for non surgical periodontal therapy with clients who have chronic periodontitis. Dental hygienists also need to consider cost effectiveness, therapeutic time, and client comfort when choosing a periodontal therapy modality. Furthermore, continued research on the use of the Er:YAG laser in conjunction with traditional SRP should be another consideration for future studies.

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Conflict of Interest

The author declares that there was no funding for this review and no conflict of interest.

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    The reference style is based on Vancouver style, the preferred choice in medical journals. 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 previously named 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]). The Reference section lists these in numerical order as they appear in the text. http://www.nlm.nih.gov/bsd/uniform_requirements.html

Samples:

Journal articles
Books and other monographs
Other publications
Unpublished material
Electronic material

Journal articles

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

Volume with supplement
Orban B, Manella VB. A macroscopic and microscopic study of instruments designed for root planing. *J Periodontal*. 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.

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.

No author
What is your role in the profession? [editorial] *J Dent Topics*. 1999;43:16–7.

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.

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.

Personal communication
These should be cited in parentheses in the body of the text. The author should obtain permission from the source to cite the communication.

Other publications

Newspaper article
Rensberger B, Specter B. CFCs may be destroyed by natural process. *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)

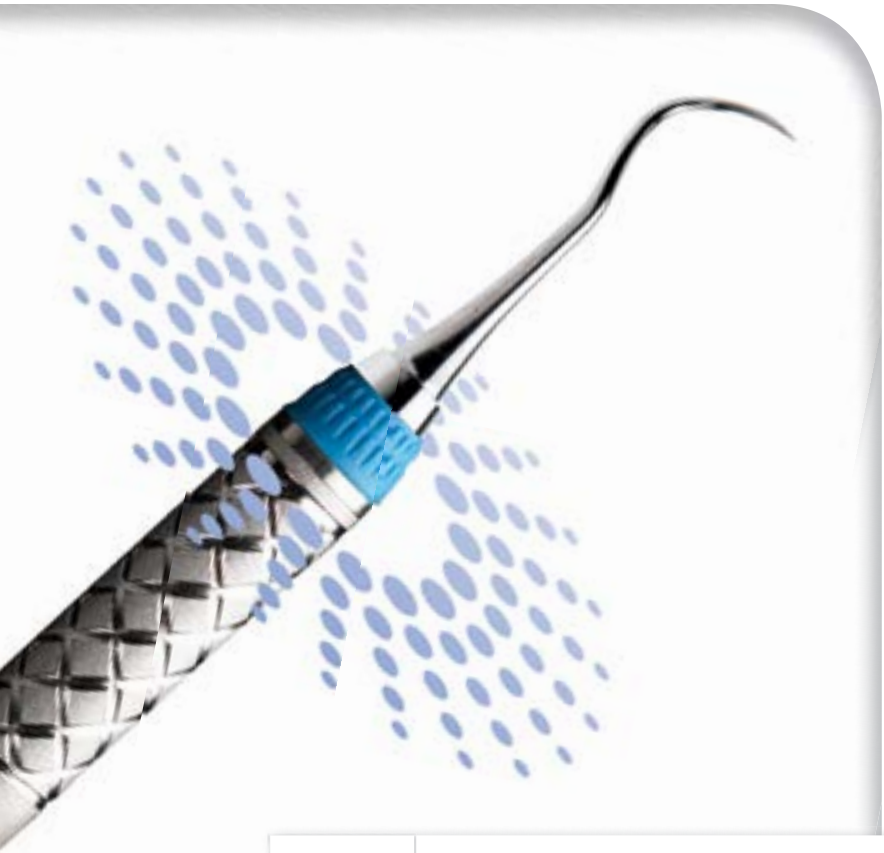
Electronic material

Monograph on Internet
National Library of Canada. *Canadiana quick reference* [monograph on the Internet]. Ottawa: The Library; 2000 [cited 2003 Nov 30]. Available from: http://www.nlc-bnc.ca/8/11/index-e.html

Journal on Internet
Walsh MM. Improving health and saving lives. *Dimensions Dent Hyg* [serial on Internet] 2003 Nov/Dec [cited 2004 Jan 12] Available from: http://www.dimensionsofdentalhygiene.com/nov_dec/saving_lives.htm

Homepage/web site
Canadian Dental Hygienists Association [homepage on the Internet]. Ottawa: CDHA; c1995 – [cited 2003 Nov 20]. Available from: http://www.cdha.ca/

(Last updated: July 2012)



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