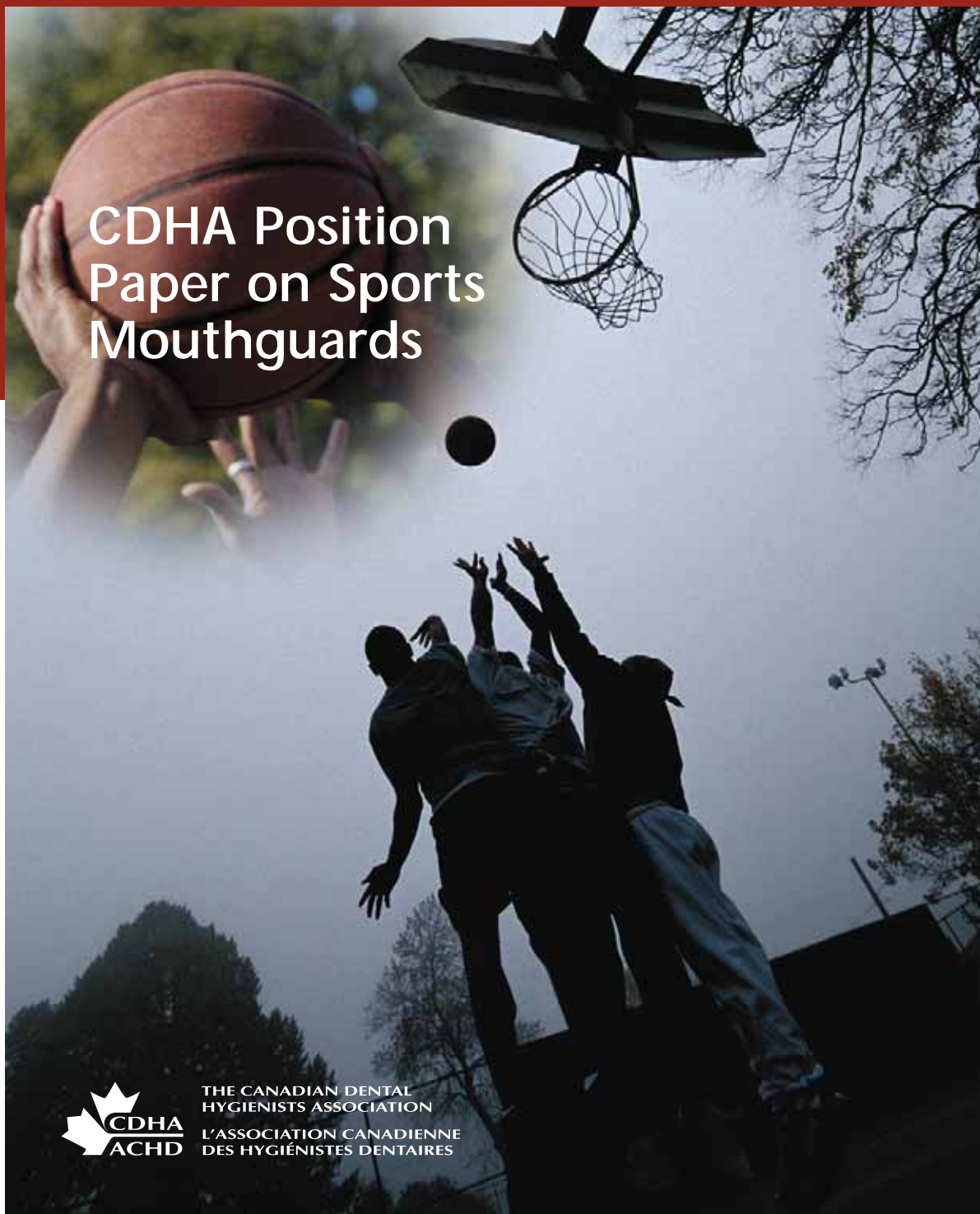


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CDHA Position Paper on Sports Mouthguards



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

Step Out of Your Comfort Zone

by Diane Thériault, RDH



IT'S HARD TO BELIEVE ANOTHER YEAR IS almost over. As the holiday season approaches, I am taking a few moments to reflect on all the personal and professional struggles and achievements of 2005. I find this exercise valuable—I learn from my experiences and set new goals. I invite you to do the same, to take stock of the past year and decide on new resolutions or challenges for the coming year.

We all have an inherent tendency to do only the things within our own personal comfort zones.

The New Year is a time for renewals and new resolutions. I encourage you to create a list of things you would like to accomplish and establish some targets for yourself. A first step is looking at what you have not managed to get done over the past year and making a commitment that they *will* be done. Life's obligations sometime force us to delay certain goals that are dear to us, but it's never too late to dust off these plans and to put them into action. Furthermore, there is no better time than now to step out of your comfort zone and undertake a challenge previously too daunting.

This sounds simple but it isn't. We all have an inherent tendency to do only the things within our own personal comfort zones. Indeed, we tend to talk ourselves out of doing something new rather than motivating ourselves to embark on a new adventure. At the 2005 Annual World Dental Congress in Montreal, Bruce Christopher gave a wonderful presentation on the topic of personal attitude and self-esteem. His most important message was that "the most important thing about me is how I talk to myself." We must all recondition our minds to adopt a can-do attitude toward the unknown and new challenges. Of course I wouldn't challenge someone to face his/her fear of heights by parachuting out of a plane. However, I think we can all look at expanding our comfort zone in small increments every year. Taking on new challenges and trying things you've previously been afraid to attempt can only serve to expand your horizons and lead to a fuller life.

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Sortir de sa zone de confort

par Diane Thériault, RDH

ON A PEINE À LE CROIRE, MAIS VOILÀ UNE autre année qui achève. À l'approche de la saison des Fêtes, je prends quelques instants pour réfléchir à toutes mes luttes et réalisations personnelles et professionnelles de 2005. Il s'agit là selon moi d'un exercice très utile, car je tire des leçons de mes expériences et je me fixe de nouveaux objectifs. Je vous invite à faire de même, à faire le point sur l'année écoulée et à choisir finalement de nouvelles résolutions ou de nouveaux défis pour l'année qui vient.

L'arrivée de la nouvelle année est un moment de renouvellements et de nouvelles résolutions. Je vous encourage à dresser la liste des choses que vous aimeriez accomplir et à vous assigner certains objectifs. Il s'agit d'abord de vous pencher sur ce que vous n'avez pas réussi à faire au cours de la dernière année et à prendre l'engagement de le faire. Les obligations de la vie nous forcent parfois à reporter la réalisation de certains objectifs qui nous tiennent à cœur, mais il n'est jamais trop tard pour dépoussiérer ces plans et les mettre à exécution. En outre, il n'y a pas de meilleur moment que maintenant pour sortir de sa zone de confort et s'attaquer à une tâche jugée auparavant trop décourageante.

Nous sommes toutes portées ou tous portés, de manière intrinsèque, à ne faire que ce qui se situe à l'intérieur de notre propre zone de confort.

Voilà qui paraît simple, mais en réalité, ce n'est pas le cas. Nous sommes toutes portées ou tous portés, de manière intrinsèque, à ne faire que ce qui se situe à l'intérieur de notre propre zone de confort. En effet, nous avons tendance à nous dissuader de faire quelque chose de nouveau plutôt que de nous motiver à nous lancer dans une nouvelle aventure. Lors du Congrès dentaire mondial annuel de 2005, à Montréal, Bruce Christopher a présenté un excellent exposé à propos de l'attitude personnelle et de l'estime de soi. Le message le plus important qu'il ait livré est : « Ce qu'il y a de plus important à mon sujet, c'est la façon dont je me parle. » Il nous faut tous reconditionner notre esprit pour adopter une attitude résolue à l'égard de l'inconnu et des nouveaux défis. Évidemment,

Sortir de sa zone de confort ...suite page 295

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New Beginnings

by Susan Ziebarth, BSc, MHA, CHE

You don't just stumble into your future. You create your own future.

– Roger Smith, CEO of General Motors



Nouveaux débuts

par Susan Ziebarth, B.Sc., M.H.A., C.H.E.

On ne fait pas qu'entrer en trébuchant dans son avenir; on crée son propre avenir.

– Roger Smith, chef de la direction de General Motors

THIS ISSUE OF THE JOURNAL FALLS AT THE BEGINNING of the CDHA membership year and near the end of the calendar year. In my mind, this strengthens the linkage between endings and beginnings, the past and the future. As the year draws to a close, let's look at some of the things that may impact the future of dental hygiene.

- Self-regulation is on the agenda of several provincial governments.
- The removal of the "order" in Ontario is on the government agenda.
- Scope of practice issues are the front of the mind for many oral health professionals.
- A new position in the federal government was created: Chief Dental Officer with Dr. Peter Cooney as the first appointee. This is a strong step forward in recognizing oral health as an issue for Canadians. The appointment may present an opening to have dental hygienists' issues heard at a fairly high level within government.

We must be active participants in creating our future, not just letting it happen to us.

- The new Public Health Agency of Canada and a new position of Chief Public Health Officer were established this year. This new emphasis on public health may be the opportunity to re-build the public health dental hygiene positions that have been eroded over the last 10 years.
- Private dental hygiene schools are graduating significant numbers of new graduates into the workforce from their time-compressed diploma courses.
- Articulation agreements between colleges and universities are beginning to emerge in order to enable diploma graduates to pursue baccalaureate degrees.
- The American Dental Hygienists' Association has created a 5-year plan for establishing the baccalaureate degree as entry to practice and a 10-year plan for master's degrees and doctoral dental hygiene programs.

New Beginnings ...continued on page 296

LE PRÉSENT NUMÉRO DU JOURNAL ARRIVE AU DÉBUT DE la période de renouvellement des cotisations à l'ACHD et vers la fin de l'année civile. Dans mon esprit, cela renforce les liens entre les commencements et les fins, le passé et le futur. Au moment où l'année s'achève, penchons-nous sur quelques sujets qui risquent d'avoir des effets sur l'avenir de l'hygiène dentaire.

- L'autoréglementation est au programme de plusieurs gouvernements provinciaux.
- L'élimination de l'« ordre » en Ontario apparaît au programme du gouvernement.

Nous devons être des participants actifs dans la création de notre avenir et ne pas laisser uniquement les choses nous arriver.

- Les questions relatives à l'envergure de la pratique figurent au premier rang des préoccupations chez bon nombre de professionnels de la santé bucco-dentaire.
- Le gouvernement fédéral a créé un nouveau poste : celui de dentiste en chef, dont le premier titulaire est le Dr Peter Cooney. C'est là un grand pas en avant dans la reconnaissance de la santé bucco-dentaire comme problème pour les Canadiennes et les Canadiens. Grâce à cette nomination, peut-être les préoccupations des hygiénistes dentaires ont-elles des chances d'être prises en considération à un niveau relativement élevé de l'Administration fédérale.
- La nouvelle Agence de santé publique du Canada et le nouveau poste de dentiste en chef ont été créés cette année. Cette nouvelle insistance sur la santé publique pourrait bien être l'occasion de rétablir les postes d'hygiénistes dentaires en santé publique qui ont été perdus au cours des dix dernières années.
- Les écoles d'hygiène dentaire privées produisent en grand nombre de nouveaux diplômés qui entrent sur le

Nouveaux débuts ...suite page 295

CDHA Position Paper on Sports Mouthguards

Putting More Bite into Injury Prevention

by the Canadian Dental Hygienists Association

CDHA POSITION STATEMENT ON SPORTS MOUTHGUARDS

Research shows that orofacial injury in sport is prevalent and carries significant medical, financial, cognitive, psychological and social costs. Research also confirms that mouthguards can prevent orofacial injuries. The CDHA therefore strongly recommends that dental hygienists play an integral role in the prevention of orofacial injury in sports and promote properly fitted mouthguards as an essential piece of protective equipment, in sports that present a risk of orofacial injury at the recreational and competitive level, in both practices and games.

INTRODUCTION

PARTICIPATION IN SPORTS MAKES A POSITIVE AND POWERFUL contribution to social, personal, and physical development. It helps promote the adoption of a healthy lifestyle and prevention of diseases and illness. Despite these benefits, there are some risks involved with sport participation, including a risk of orofacial injury. This risk exists in contact sports such as rugby, and hockey, but also in sports with less contact, such as basketball, soccer and baseball. Estimates of the number of dental injuries attributable to sports related accidents range from 13 to 39%^{1,2} of all dental injuries. Every individual involved in contact sport has at least a 10% chance each season of sustaining an orofacial injury.^{3,4}

These injuries can occur during organized competitive sports as well as unorganized recreational activities. Orofacial injuries may be caused by a sudden fall; an elbow to the jaw in basketball; a ball to the teeth in softball; and high-sticking, cross-checking, and slashing in hockey. Hockey pucks, 6-ounce pieces of solid rubber, can hit a hockey player's mouth at approximately 120 mph and hit their teeth with an impact force of 1,250 lb.¹ The main instances of orofacial injury in non-contact sport results from projectiles such as baseballs, tennis balls, or bats hitting the face. Injuries to the teeth include crown fractures which occur due to high-velocity trauma from an object such as a baseball; root fractures; and displacements (luxations), which occur due to low-velocity trauma from an elbow or entanglement in a basketball net.

The majority of orofacial injuries affect the upper jaw, with maxillary incisor injuries accounting for 80% of all cases.⁵ Early trauma to the mouth may result in damaged teeth that may exfoliate abnormally; permanent teeth that fail to erupt; colour changes in teeth; infections in which painful abscesses develop; injury to underlying permanent teeth, such as localized enamel hypoplasia⁶ on the surface of the crown; and tooth loss that leaves unwanted open spaces.

Most orofacial injuries occurring from sports activities can be painlessly avoided by using a mouthguard. Mouthguards are removable appliances that protect intra-



Mouthguards are removable appliances that protect intra-oral soft tissue...from lacerations and bruising.

oral soft tissue—such as lips, cheeks, and gums—from lacerations and bruising. They prevent chipping, luxations, avulsions; fractured teeth, roots, and bones; mandibular/maxillary fractures; and temporomandibular dysfunction. (See Appendix B for tooth injury definitions and Appendix C for categories of orofacial injuries.)

In 1892, the first mouthguard was made by Woolf Krause. There was no mention of mouthguards again until 1915 when a professional boxer named Ted “Kid” Lewis used a mouthguard during a championship bout. This mouthguard, or “gum shield” as it was referred to at that time, was fabricated by Jacob “Jack” Marks of London, England and consisted of a custom-fitted rubber strip that fit under the lips and over the outer surfaces of the teeth and gingival.^{7,8}

The total health service costs in Ontario... were estimated to be between US\$22 million and US\$25 million.

Between 1950 and 1965, extensive field studies and material testing took place in the United States.⁹ In 1962, the U.S. National Alliance Football Rules Committee adopted a mandatory mouthguard rule for high school and junior college football, and recommended that an impression of the mouth be used in fabricating the mouthguard. In 1973, the National Collegiate Athletic Association (NCAA) made mouthguards mandatory football equipment.¹⁰ After mouthguards and facemasks became mandatory for amateur football, the incidence of facial and dental injuries fell from 2.26 per 100 players to 0.30.¹¹ Then in 1975, USA Hockey, the national governing body for hockey adopted a mandatory mouthguard rule. In 1974, NCAA made the use of mouthguards mandatory for ice hockey, field hockey and lacrosse.⁷

The requirement to use mouthguards varies by sport and the position on the team. Requirements also vary from one city and province to the next in Canada. Boxing is the only professional sport that requires mouthguards. Mouthguards are required in four states for soccer, in three states for basketball; and in two states for wrestling.¹² Currently in Canada, mouthguards are required in the following amateur sports: football, rugby, lacrosse, field hockey, and boxing.^{11,13-15} Hockey Canada, the governing body for amateur hockey in Canada, has no mandatory mouthguard rule, but it recommends mouthguard use for contact hockey. Local hockey governing bodies at the league or provincial branch level across Canada have begun to implement mandatory mouthguards within their jurisdictions. For example, the Canadian Hockey League, which is the major junior league, has made mandatory the use of mouthguards for girls and boys. Orofacial injury prevention is still lagging behind in baseball, basketball, soccer, field hockey, softball, wrestling, volleyball and gymnastics, and in most of the professional sports.

PSYCHOLOGICAL, SOCIAL AND ECONOMIC COSTS

The smile and the aesthetics of the anterior dentition play an important psychosocial role in human relationships. Sports injuries that cause orofacial disfigurement or negatively affect the appearance and position of anterior teeth may have a negative psychosocial impact. A study using the Oral Impact on Daily Performance Index was carried out in 2002 comparing the quality of life of 189 children with and without traumatic dental injuries. Results showed that children with injured but untreated anterior teeth were 20 times (95% CI CI=2.2-45.6) more likely to report a negative impact on quality of life.¹⁶ The children with untreated fractured teeth reported embarrassment; emotional problems; and avoidance of social contact, eating, and enjoying contact with people. They

were also more likely to be teased about their teeth. These findings point to the possibility that children with unrepaired orofacial injuries may be at risk of long-term psychological and social distress.

Mandibular fractures, dentoalveolar fractures, and temporomandibular joint injuries can also occur in sports and may require long-term care. Extended health problems may result in reduced participation in sport and exercise. This in turn may contribute to a decrease in health, increased medical, economic and societal costs, which may include work or school absenteeism.

Although there are few studies examining dental injury costs, Locker and Maggias calculated two types of costs associated with traumatic dental injuries that were caused by a broad array of factors, including sports injuries.¹⁷ The direct treatment costs in Ontario are estimated at between \$3.2 million and \$4.98 million per year. Using data derived from international cost estimates, the total health service costs in Ontario, including direct and indirect costs, were estimated to be between US\$22 million and US\$25 million. Another study estimated the total costs for repairing one avulsed tooth at more than 20 times the cost of a custom-fabricated mouthguard and the lifetime costs associated with this one tooth may exceed \$15,000.¹ The cost of a mouthguard appears to be well worth the expense, since it can prevent costly treatment of injuries.

POSITION STATEMENTS of VARIOUS HEALTH ORGANIZATIONS

A number of associations and organizations consider orofacial injury to be an important public health issue and have adopted position statements on injury prevention and the use of mouthguards. Notable in the following list is the paucity of Canadian organizations with position statements on mouthguards.

- The Canadian Academy of Sport Medicine has a position statement on head injuries and concussions in soccer in which they call for mouthguards to be worn during participation in soccer, due to the dental protection and the possible role in concussion prevention.¹⁸
- The Canadian Dental Association has a position statement that encourages dentists to counsel clients about orofacial protection and encourages organized activities to develop safety protocols to minimize the risk of orofacial injury.¹⁹
- Several professional health organizations have recommended the use of mouthguards in a variety of contact sports at all levels of competition, both organized and unorganized. These organizations include the American Medical Association and the American Academy of Pediatrics.²⁰
- The American Academy for Sports Dentistry recommends the use of properly fitted mouthguards and supports mandates for their use in all collision and contact sports for practices and games.²¹
- The Academy of General Dentistry in the United States recommends "that players participating in basketball, softball, wrestling, soccer, lacrosse, rugby, in-line-skat-

ing and martial arts, whether for an athletic competition or leisure activity, wear mouthguards.”¹⁵

- The American Academy of Pediatric Dentistry recommends¹³ the continuation of preventive practices in youth high school and college football, lacrosse and ice hockey, and call for mandating mouthguards in other organized sporting activities with risk of orofacial injury.
- The American Public Health Association “recommends to schools and other sponsoring organizations that all participants in contact sports be required to wear quality fitted protective mouthguards.”²²
- The American Dental Association (ADA)²³ recognizes the preventive value of orofacial protectors (such as mouthguards, face shields and helmets) and endorses the use of orofacial protectors by all participants in recreational and sports activities with a significant risk of injury, all levels of competition including practice sessions, physical education and intramural programs.

- Mouthguard use is encouraged in the U.S. document Health People 2010, which outlines goals and objectives for improving oral health. One of the objectives calls for the following: “Increase the proportion of public and private schools that require use of appropriate head, face, eye, and mouth protection for students participating in school-sponsored physical activities.”²⁴ The rationale for appealing to schools is that healthy habits are formed early in life, and by the time athletes reach young adulthood they will be familiar with the hazards inherent in sports and be more familiar and comfortable with mouthguard use.

TYPES OF MOUTHGUARDS

The American Society for Testing and Materials identifies three categories of athletic mouthguards including the stock, mouth formed and custom made. These three different types of mouthguards score differently on each of the following mouthguard qualities. **Fit** is critical, since the

Déclaration sur les protège-dents dans les sports

RÉSUMÉ

Les recherches démontrent que les blessures orofaciales dans les sports sont fréquentes et coûteuses sur le plan des frais médicaux mais aussi sur les plans financier, cognitif, psychologique et social. Elles confirment également que les protège-dents peuvent prévenir les blessures orofaciales. L'ACHD recommande donc fortement que les hygiénistes dentaires jouent un rôle complet dans la prévention des blessures orofaciales dans les sports et qu'ils fassent la promotion du protège-dents ajusté correctement comme pièce essentielle de l'équipement de protection dans les sports qui présentent un risque de blessure orofaciale, qu'ils soient pratiqués dans un contexte récréatif ou compétitif.

Relativement peu d'organismes canadiens prônent l'utilisation du protège-dents en comparaison avec les organismes américains. L'appui inconditionnel de l'Association canadienne des hygiénistes dentaires en faveur de l'utilisation du protège-dents comme moyen de prévention de base contre les blessures orofaciales fait de l'ACHD un chef de file dans ce domaine, au Canada. Les hygiénistes dentaires ont une bonne occasion de protéger la santé et la sécurité des enfants et des adultes dans les sports en appuyant l'utilisation du protège-dents et en en faisant la promotion. Ce ne sont pas seulement les sports les plus rapides et les plus rudes, comme le football, le rugby et le hockey, qui causent des blessures orofaciales. Les sports qu'on estime moins dangereux, comme le soccer, le baseball, le hockey sur gazon et le basketball, sont également susceptibles de causer des blessures orofaciales.

Il existe des preuves convaincantes selon lesquelles le protège-dents peut rendre le sport plus sécuritaire en protégeant contre les blessures orofaciales. Les preuves du rôle du protège-dents dans la prévention ou dans la réduction de la gravité des commotions sont très ténues; aussi faut-il faire d'autres recherches dans ce domaine. Le protège-dents fait sur mesure, celui de type laminé en particulier, semble fournir certains avantages par rapport aux autres protège-dents : on peut en ajuster l'épaisseur en fonction du sport; on peut le prolonger jusqu'à la deuxième molaire; on peut l'articuler autour du modèle mandibulaire.

Un certain progrès a été fait en matière de prévention des blessures orofaciales depuis les années 1960 et 1970, époque où les protège-dents sont devenus obligatoires pour la première fois. Cependant, il reste encore beaucoup de chemin à parcourir dans le développement d'attitudes plus positives et dans l'augmentation de l'utilisation du protège-dents. Premièrement, il faut faire la promotion de l'utilisation généralisée du protège-dents dans tous les sports de contact. Le coût d'un protège-dents fabriqué par des professionnels de la santé bucco-dentaire est très peu élevé par comparaison avec celui des conséquences pour la santé et des conséquences financières, cognitives, psychologiques et sociales associées à une blessure orofaciale. Deuxièmement, il faut adopter une approche multidisciplinaire pour augmenter le nombre de joueurs qui portent un protège-dents. L'entraîneur, les officiels, les parents, les hygiénistes dentaires, les autres professionnels de la santé bucco-dentaire, ainsi que les professionnels de la santé de façon générale, ont tous un rôle à jouer. Ils peuvent aider la population à adopter une attitude positive envers l'utilisation du protège-dents, influencer les comportements et aider au respect des règles dans les sports où le port du protège-dents est obligatoire. Troisièmement, il faut élaborer une approche favorisant la généralisation des règles sur le port du protège-dents dans les sports.

Malheureusement, les statistiques canadiennes sur la fréquence des blessures orofaciales dans les sports sont limitées et il se peut qu'elles soient incomplètes faute de système national de surveillance. Il serait possible de combler ce fossé dans la connaissance grâce à la création d'un centre canadien de prévention des blessures. Un centre de ce genre aurait les moyens de coordonner la surveillance et de maintenir une base de données à partir des signalements de blessures orofaciales. Cette information pourrait servir à étudier l'efficacité des protège-dents; elle pourrait contribuer à l'amélioration de la conception des protège-dents et favoriser une sensibilisation accrue de la population.

RECOMMANDATIONS

L'hygiéniste dentaire peut

- collaborer avec d'autres professionnels de la santé pour effectuer des campagnes de sensibilisation en matière de santé, de prévention des blessures et de promotion du port du protège-dents soit sur une base individuelle, soit devant des groupes de clients, de parents, d'athlètes, d'équipes sportives, d'entraîneurs, d'officiels et d'enseignants en éducation physique;
- servir d'agent de changement pour influencer sur une culture dans les sports qui accepte le port du protège-dents comme élément de l'équipement de base du sport;
- fabriquer des protège-dents et prodiguer des conseils sur l'utilisation et l'entretien de protège-dents adaptés;
- effectuer des recherches sur la promotion du protège-dents en santé bucco-dentaire et sur la prévention des blessures.

Les organismes de réglementation des sports, les centres de prévention des blessures et les commissions ou conseils scolaires peuvent

- rendre obligatoire l'utilisation du protège-dents pendant les entraînements dans tous les sports présentant un risque de blessure orofaciale, y compris dans des sports comme le basketball, le baseball, et le soccer;
- élaborer un plan pour veiller au port du protège-dents dans les sports où il est obligatoire;
- accentuer la promotion de la santé et la sensibilisation auprès des entraîneurs d'athlètes, des entraîneurs d'équipes sportives, des officiels, des organisateurs, des administrateurs, des athlètes et des parents.

Les organismes professionnels en hygiène dentaire et les établissements d'enseignement peuvent

- collaborer avec les organismes sportifs nationaux et les organismes scolaires pour élaborer une approche visant à accroître la réglementation sur le protège-dents dans les sports et pour veiller à son application dans les sports qui disposent d'une réglementation sur le port du protège-dents;
- fournir régulièrement, pendant la formation collégiale, universitaire ou permanente, des occasions d'acquérir des connaissances et de l'expérience sur les questions relatives au protège-dents.

Les gouvernements peuvent

- financer des programmes de promotion de la santé et de prévention des blessures qui font appel au protège-dents;
- collaborer avec les centres régionaux et provinciaux de prévention des blessures en vue de mettre sur pied un centre canadien de prévention des blessures (CCPB); celui-ci serait chargé de gérer un système de surveillance des blessures, de surveiller l'exposition aux blessures et leur fréquence, et d'évaluer les tendances des blessures dans les activités, par suite de l'introduction d'une nouvelle pièce d'équipement ou d'une nouvelle règle;
- établir un fonds de recherche et de démonstration sur les blessures pour tester et évaluer les méthodes de prévention et de limitation des blessures.

L'industrie de l'assurance-santé peut envisager d'assurer le coût des protège-dents adaptés dans le cadre des régimes de soins de santé et de faire la promotion de l'utilisation du protège-dents fabriqué sur mesure.

Les chercheurs peuvent effectuer des recherches de haute qualité sur le protège-dents ainsi que des essais comparatifs aléatoires sur des sujets comme :

- l'efficacité de différents types de protège-dents dans la prévention des blessures et commotions orofaciales;
- la rentabilité du protège-dents;
- l'efficacité des interventions populaires et de la réglementation dans les sports visant l'accroissement du port du protège-dents – par exemple celle de l'augmentation de la sévérité des punitions pour contravention aux règles sur le port du protège-dents;
- la consultation des hygiénistes dentaires et d'autres professionnels de la santé bucco-dentaire pour établir le niveau de connaissance générale et d'expérience en ce qui a trait au port du protège-dents et déterminer les attitudes des hygiénistes dentaires en ce qui concerne la promotion du port du protège-dents;
- l'amélioration de la conception d'un protège-dents efficace et confortable qui favoriserait le respect général des règles.

mouthguard must be properly positioned at the time of impact. **Comfort** is important, since individuals will be more likely to wear mouthguards if they fit properly. **Durability** is important, since the public expects some degree of longevity with their purchase. **Ability to breathe** is important, since a good flow of oxygen means better performance and less muscle fatigue. **Ability to speak** is important, since some players must communicate verbally with team members.

Stock

Stock mouthguards are commercially available in stores and are worn without any modifications. They are easy to use but have a number of limitations, including poor fit that may lead to discomfort and low user compliance. They may also restrict breathing and speech. Since they generally do not have a high degree of conformity with the teeth, the wearer has to clench the teeth to hold the mouthguard in place. A mouthguard that shifts and allows gaps between the teeth and the guard offers reduced protection. Also, they may not last as long as a custom-fabricated mouthguard.²¹ They are generally considered inferior to the other types of mouthguards, particularly the custom-fabricated mouthguard, in terms of retention, protection, and comfort.^{25,26}

Mouth-formed

The mouth-formed mouthguards—also referred to as boil-and-bite mouthguards—are the most commonly used type of mouthguard. Some of the advantages include a low price (compared with custom-fabricated mouthguards) and a removable strap that allows them to be attached to a helmet. They also are less bulky than stock mouthguards and offer a fair potential for proper fit. This mouthguard may be good for growing children, since it can be remoulded over time.

Mouth-formed mouthguards are the most commonly used type of mouthguard.

There is a new generation of anatomically designed mouth-formed mouthguards, more expensive than the earlier version, that may provide a better fit. Retention, protection, and comfort are improved over the earlier versions; however, they may require an adjustment by an oral health professional.²⁷

The positive aspects of the mouth-formed mouthguard are overshadowed by several significant drawbacks, including inadequate coverage of teeth, loose fit, and decreased air flow. In addition, there is an inability to control the degree of pressure that is used in biting down on the softened material during the formation process. One study found that the mouth-formed mouthguards do not properly cover all posterior teeth in 85% of athletes tested.²⁸ In a 1994 study by DeYoung et al.,²⁹ 42% of athletes

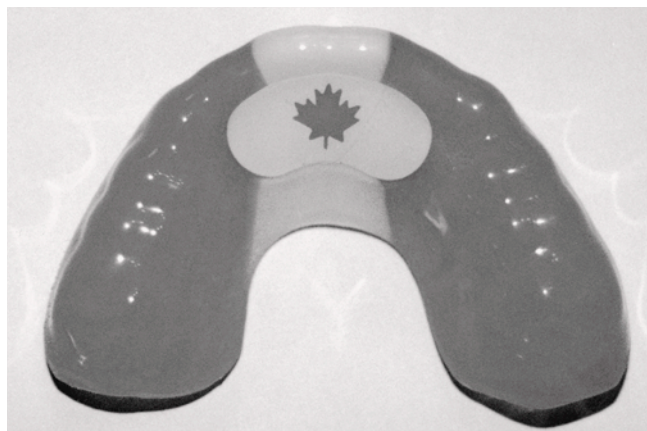
indicated that both the stock and mouth-formed mouthguards had a loose fit compared with the custom-made type. As with the stock mouthguards, this loose fit may force the wearer to hold the mouthguard in place by clenching the teeth. Bemelmans and Pfeiffer conducted a biomechanical study in 2001 to test the shock absorption capacities of mouthguards in a laboratory and found that the boil-and-bite type of mouthguard was inferior to the other types.³⁰

Delaney and Montgomery³¹ conducted a prospective crossover study in 2005 using a skating treadmill to simulate the intensity of a hockey game. They found that 12 hockey players who wore a non-custom bimolar mouthguard experienced significantly lower expired ventilation (VE) (108.5 l/min) ($P<0.05$) and significantly lower oxygen uptake (VO₂) (48.8mL) ($P<0.05$), at maximal effort, compared with the athletes not wearing a mouthguard. Although these results are limited due to the small number of subjects, this preliminary research indicates a need for a larger study comparing non-custom with custom-fabricated mouthguards.

Custom-fabricated

The custom-fabricated mouthguards are created using a mould or impression of the dentition using an alginate material. They can be fabricated from the cast in-house by a dental hygienist, or the cast can be sent out to a laboratory. Once the mouthguard is formed, it is trimmed and polished to allow for proper tooth and gum adaptation. The mouthguard may be coloured to increase the ease of retrieval should it be dislodged during a practice or game, and the date and clients' name can be embedded in the mouthguard. For example, in a sport like water polo, it is difficult to find a blue or clear mouthguard.

Custom-fabricated mouthguards are considered to provide superior comfort, retention and protection compared with the other mouthguard types.²⁷ Newsome et al. conducted a review in 2001 of four studies⁵ comparing custom made and mouth-formed mouthguards. It shows that custom-fabricated mouthguards consistently provide better fit, allow the athlete to breathe and speak more easily, and are more comfortable than mouth-formed mouthguards. DeYoung et al.²⁹ conducted a study in 1994 with 20 female and 16 male high school students, comparing custom-



made and mouth-formed mouthguards. The participants scored the custom-made mouthguard higher on a number of comfort and wearability factors, including mouth irritation, tightness or looseness, bulkiness, difficulty speaking, difficulties breathing. Overall, 86.1% of the participants preferred the custom mouthguard.

One of the reasons that the custom-fabricated mouthguard is considered more comfortable is that it provides an optimal fit. It maintains its position in the mouth without the need for the wearer to bite down on the mouthguard. This may translate into better acceptance, and compliance. The custom-made mouthguard also has a longer life span than the other mouthguards, which may be more likely to harden or tear over time.³²

More importantly, custom-made mouthguards are reported to provide better protection than the other types of mouthguards.³² Echlin et al. in 2005 reviewed the literature on this topic and found that four studies conclude the custom-fabricated mouthguards provide superior protection to the stock and mouth-formed type.³³ There is one minor drawback to the custom-formed mouthguard: it costs more than other types of mouthguards.

Custom-made mouthguards can be fabricated using a vacuum or a pressure lamination machine. Although there is much debate about which technique is best, and the studies presented below attempt to answer this question, there is a need for a larger number of studies, including randomized controlled trials.

Vacuum-formed mouthguards

The vacuum-formed mouthguards are fabricated using a single layer of thermoplastic material that is adapted over the mould with a vacuum machine. Vacuum-forming machines are simpler and less expensive than pressure-forming machines. Vacuum-forming the mouthguard using a wet model may create difficulty with the fit, so some researchers recommend using a dry model cast³⁴ with its surface temperature elevated³⁵ in order to obtain a better fit. Park et al.³⁶ note some deficiencies with vacuum-formed mouthguards: the incisal edges can become thin,

and the occlusal, labial, and lingual aspects of the mouthguard can shrink.

Pressure-laminated mouthguards

Some studies indicate that the pressure-laminated mouthguard may have superior fit, comfort, and protection, with negligible deformation when worn for a period of time compared with other mouthguards. The pressure-lamination process provides some advantages over the single-layer vacuum-formed design. It allows layering of material to a specific thickness to suit the specific sport and can provide added protection to certain vulnerable areas in the mouth, as required. In a study of 60 mouthguards by Waked et al. in 2002 that simulated the effects of aging on mouthguard type, the pressure-laminated mouthguards, constructed from two 3-mm sheets, showed the best stability compared with the vacuum-formed mouthguards and the least number of changes in mouthguard shape over time.³⁷ Newsome et al.⁵ in 2001 conducted a review of the efficacy of different types of mouthguards and concluded that the pressure-laminated variety provided the most protection.

DESIGN, CONSTRUCTION, AND MATERIALS ISSUES

Occlusal contact

In 2004, Takeda et al.³⁸ studied different occlusal conditions of a two-layer laminated mouthguard at the occlusal supportive areas, using an artificial skull model and a pendulum impact device. The researchers noted that wearing a mouthguard without good occlusal contact over a large area can potentially cause a bone fracture of the mandible. The appropriate occlusal relationship and incisal guidance can only be achieved if an impression of the opposing arch is made. Only the pressure-laminated mouthguard (not the one-layered vacuum-type mouthguards) permit sufficient occlusal thickness to be created.

Thickness

In 2005, Waked and Caputo³⁹ noted that an interocclusal space at physiologic rest position is 2 to 4 mm from

Study	Basketball	Baseball	Soccer
Kumamoto and Maeda, 2004 ¹⁰	U.S., 11.8% & 12.1%; Finland, 5.8% & 5.2%; Japan, 2.3%; Females 14 to 7.5%; Female Olympic, 1.3%	12.7% to 37%	6 studies: 2.8 to 13.8% 6 studies with small sample size: 9 to 20%
Kvittem et al. 1998 ⁷⁷	30.9%, 1020 athletes		
Ferrari and Medeiros, 2002 ⁵⁹	36.4%		23.1%
Yamada et al., 1998 ⁷⁸			32.3%
U.S. Department of Health and Human Services 2000 ⁷⁹	34% of all injuries are orofacial		

Table 1. Injury rate in sports

tooth contact. They therefore recommend a mouthguard with a thickness greater than 3 mm so the arches are adequately separated. These researchers conducted a study with 10 vacuum-formed and 10 pressure-laminated mouthguards. The pressure-laminated mouthguard produced material thicknesses greater than 3 mm, consistently thicker than the vacuum-formed mouthguard. The results may indicate that the pressure-laminated mouthguard allows the creation of a thicker mouthguard that fits the interocclusal space better.

Design at different angles

In 2004, Patrick et al.³⁴ identified the following criteria for design of the pressure laminated mouthguard:

- The mouthguard should enclose the maxillary teeth to the distal surface of the second molars.
- Thickness should be 3 mm on the labial aspects, 2 mm on the occlusal aspect, and 1 mm on the palatal aspect.
- The palatal flange should extend about 10 mm above the gingival margin.
- The labial flange should extend to within 2 mm of the vestibular reflection.
- The edge of the labial flange should be rounded in cross-section whereas the palatal edge should be tapered.
- When a maxillary guard is constructed, it should be articulated against the matching mandibular model for optimum comfort.

In a 1999 study by McClelland et al., 22 participants reported that the last three features mentioned above created a mouthguard that was more comfortable to the lips, gums, and tongue; felt less bulky; was less likely to keep the teeth apart or to cause pain in the jaw muscles compared with a mouthguard that was under-extended and had an unadjusted occlusion.⁴⁰

A research study examining the length of the distal end of the mouthguard and response to simulated impact shows that a mouthguard should cover at least up to the second molar to ensure efficient absorption and/or disper-

A review of the efficacy of different types of mouthguards concluded that the pressure-laminated variety provided the most protection.

sion of force.⁴¹ Other researchers argue for extending the guard as far back onto the molar areas as the client can tolerate, to maximize the force dissipation.³² In addition, some league rules require full molar coverage; however, care must be taken in fabrication, as many athletes cannot tolerate guards that extend to the third molars.

Rebound and thickness testing

Guevara et al.⁴² conducted a study in 2001 comparing 19 vacuum-formed mouthguards with 10 mouth-formed mouthguards. They found that the vacuum-formed mouthguard did not perform as expected and produced the lowest value on the tests for rebound and thickness in the incisor region. This suggests that caution should be taken in making the vacuum-formed mouthguard to ensure that adequate thickness of material is located over the incisors. The mouth-formed mouthguard had problems with slumping of the facial portion of the mouthguard after boiling. This resulted in thicker material over the occlusal surface but a lack of material over the facial surface of the posterior teeth. The other surprising finding was that none of the mouthguards tested achieved the standard of at least 50% rebound, established as a minimum requirement by ANSI/ADA Specification No. 99. It should be noted that not all custom-made mouthguards have problems with thickness in the incisor region; as Waked et al. point out, the pressure laminate mouthguard gives the best results in the incisor region.³⁷

Westerman et al. conducted two studies of the inclusion of air or gas into the EVA (ethylene vinyl acetate) mouthguard material to determine if it will improve perform-

Hockey	Field hockey	Bicycle	Rugby	Football	Martial arts
11.5% of all reported injuries	Rates are lower than in ice hockey	5.6% of all injuries	Rates are similar to football rates prior to mandating of mouthguards	Prior to mouthguard rules: 54%; Post rule: significantly reduced	
11.5%			56.5%		32.1%

Researcher/participant	Football	Soccer	Basketball	Baseball
U.S. Department of Health and Human Services (U.S. children) ⁷⁹	72%	7%	4%	7%
Woodmansey KF., 1997. ⁷ 557 British children				
Nowjack-Raymer RE, Gift HC, 1996. ⁵² Children	Majority			
Braham RA, Finch CF, Australia RCT., 2003 ⁸⁰	100% (games)* 0% (practices)			
Hawn KL, Visser F, Sexton PJ, 2003. ⁸¹ 104 U.S., certified hockey trainers				
Ferrari CH, Medeiros JMF, 2002. ⁵⁹ 204 professional and semi-professional		1.4%	2.1%	
Yamada T et al., 1998. ⁷⁸ 2670 Japanese males		0.8%		
Comstock et al., 2005. ⁸² 234 females				
Ranalli, 1995. ¹⁴ US college level	33% custom-made; 33% custom-made and mouth-formed; 27% boil and bite			
Bolhuis J, et al. 1987. ⁸³ International players				
Berry et al. 2005. ⁵⁸ 165 Central Collegiate				
Comstock et al. 2005. ⁸² 234 females				

* mouthguards are not mandatory in Australian football

Table 2. Utilization rates

ance. The first study was conducted in 2002,⁴³ using regulated air inclusion in an EVA mouthguard material (Shore A Hardness of 85). The air inclusion was found to reduce the transmitted force by as much as 32% when tested with a pendulum impact.

However, the second study in 2002 did not show the same energy absorbing qualities of air inclusion.⁴⁴ This study examined results of simulated impact on two types of mouthguard materials. The control was an EVA polymer (with Shore A hardness 83) and the test samples were the same EVA polymer injected with a foaming agent to form indiscriminate gas cells throughout the polymer. The researchers found that the foaming agent did not produce statistically significant improvements in the impact performance, measured by improvements in energy absorption, and reductions in transmitted forces of the EVA material.

Types of arch casts

Generally, single-arch mouthguards are fabricated for the maxillary teeth. However, dual-arch mouthguards—also called bimaxillary mouthguards—cover the upper and lower teeth and provide more protection for the jaw joint

and the mandible compared with a single-arch mouthguard.⁴⁵⁻⁴⁷ The lower guard can be help to cushion the lower teeth with orthodontic fixtures or space maintainers fixed on the lower teeth.⁴⁴ However, athlete compliance may be low, due to a lack of comfort. The American Society for Testing and Materials (ASTM) recommends that mouthguards for individuals with a class I or II malocclusion should be constructed using a maxillary arch impression; those with a class III malocclusion should use a mandibular arch impression.²⁷ However, further research in this area may be warranted since most injuries occur in the maxillary incisors and the mandibular arch impression leaves this area unprotected.

Material and comfort

In 2001, Brionnet et al.⁴⁸ conducted a study with 48 male rugby players aged 14–18 who provided feedback on the comfort of acrylic resin and silicone rubber custom-made bimaxillary mouthguards. Overall, players found the mouthguards quite comfortable and reported no difference in responses to the two types of mouthguard materials. The silicone rubber (a softer material than acrylic resin) mouthguards were less stable than the acrylic ones, since the softer material was broken down more quickly by

	Hockey	Martial arts	Handball	Rugby	Field hockey	All sports
						6%
	Not routinely worn and not consistently enforced					
	91.3%	13%	4%			
				24.1%		
				90.8%		
					43%	
	17.1% - 50% of time					
				66.7% of scrum halves; 80% of other players		

excessive chewing. Thus a reduction in hardness in mouthguards is linked to an improvement in shock absorption but retention increases with the hardness of the material. Therefore, the researchers suggest that further research be conducted to develop a silicone mouthguard with sufficient hardness to allow greater retention and increased stability (i.e. not breaking down as readily) but that still maintains the resiliency needed for shock absorption.

EPIDEMIOLOGY

A 2003 literature review by Kumamoto and Maeda,¹⁰ which included 104 articles published on international sports-related orofacial trauma during the last 20 years, indicates that the injury rates varied depending on the age of the athletes, the sport, and the geographical location of the sample groups. The results are shown in table 1. Caution should be taken when comparing the numbers in this chart since the definition of injury varies from one reporting body to the next. For example in the National Collegiate Athletic Association players must miss a game or a practice in order for the incident to be counted as an injury and in the International Ice Hockey Federation any dental injury or laceration is recorded as an injury.

With this limitation in mind, there are still some interesting findings from the injury data. Injury rates in basketball are higher than in football and ice hockey where mouthguards are mandatory.^{10,49} For example, a pilot study on this topic indicates that a soccer player is more likely to sustain an orofacial injury than a football player and a basketball player is twice as likely.⁴ Injury rates are lower in countries where sports are less popular and higher in countries where they are very popular. Although there are mixed results when comparing female and male rates, the burden of the evidence shows that males have higher rates than females.^{10,50} In basketball and soccer, older athletes tend to have fewer dental injuries than younger players. Similar results were found in a study with children aged 7 to 13 years who showed increased risk, possibly due to adolescent growth spurts that may cause difficulty adjusting to new body proportions.¹⁰ The high incidence of dental injuries during practice sessions indicates that mouthguards should be worn not only in competitive games but also during practices.³²

It is clear from the research that participation in a number of sports carries considerable risk of orofacial injury. This risk exists in contact sports such as rugby and hockey but also in sports with less contact such as basketball and

Researcher/participants	Football	Basketball
U.S. Department of Health and Human Services, 2000 ⁷⁹	Mouthguard and facemask: <1% risk of injury	30% reduced risk
Labella, Smith, & Sigurdsson, 2002. ⁸⁴ Prospective study with 37 athletic trainers		# of injuries per 1,000 athlete exposures - Custom fabricated vs. no protection: (0.12 vs 0.67; P < 0.05)
Jolly, Messer, & Manton, 1996. ⁸⁵ Retrospective study	Half as many orodental fractures and tooth avulsions as players who didn't wear a mouthguard	
Ranalli, 1991 ⁸⁶	Incidence pre-mouthguard rule: 2.26; post-mouthguard rule: 0.30 per 100 players	
Flanders & BHAT, 1995. ⁴⁹ Pilot with 820 football and 120 basketball players	1.4 per 10,000 athletic exposures; ⁸⁷ with mandatory mouthguard practice	18.3 injuries per 10,000 athletic exposures; no mandatory mouthguard rule
Marshall SW, Loomis DP, Waller AE, Chalmers DJ, Bird YN, Quarrie KL, Feehan, 2005. ⁶⁵ 240 male and 87 females; adjusted data for covariates such as level of competition, playing position, and injury history		

Table 3. Mouthguard efficacy in preventing orofacial injury

soccer. It is also clear that there is a lack of information in Canada. This gap is addressed in the recent draft of the Pan Canadian Injury Prevention Strategy⁵¹ by SmartRisk. This Strategy identifies the need for the Public Health Agency of Canada to create an Injury Prevention Centre. Such a centre could play a coordinating role in setting national injury prevention targets and could coordinate surveillance, research and programming.

UTILIZATION RATES and BEHAVIOURAL ASPECTS OF MOUTHGUARD WEARING

The utilization rate for mouthguard use varies by sport and although they are mandated in some sports, table 2 shows their use remains very low.^{10,20,52,53} Although approximately 40 years of research shows the benefits of mouthguards, the athletic community has not fully incorporated their use. There is therefore a need to address compliance issues in sports that already make the use of mouthguards mandatory. The table also shows that statistical data are lacking in some sports such as cycling, gymnastics, or skateboarding.²⁰

The utilization rate and behavioural aspects of mouthguards are influenced by the attitudes of players, officials, coaches, and parents. For mouthguards to be effective, they must be well accepted and adopted by athletes. It is clear by the statistics in football, where mouthguards are mandatory, that factors other than the risk of a penalty are influencing a player's decision to wear a mouthguard. For example, a survey of 102 rugby players taken during the second rugby world cup in 1991⁵⁴ shows that although all

the players believed that mouthguards provided protection, approximately one in five did not wear one. This gap between players' beliefs and their behaviour is also reported in a study by Cornwell et al.⁵⁵ Similar findings emerge: even though players realized the benefits of mouthguard use, they frequently did not wear one.

Athletes do not wear a mouthguard for a number of reasons. Lack of mandatory requirements in sports, lack of knowledge about the protective qualities of mouthguards, their cost and the negative effect on their appearance all play a role. Attitudes towards mouthguard use may also be partly influenced by professional sport practices. For example, two of the most visible contact professional sports, hockey and football, do not require mouthguard use.

Players' attitudes towards mouthguards depend on esthetics and the perceived image that they create; comfort, since some mouthguards may cause a headache; and how difficult the mouthguards make talking, and breathing. In a study of male high school basketball players, some of the reasons that players gave for not wearing a mouthguard include discomfort, difficulty with breathing, and difficulty with speaking.⁵⁶ This may be because most players were wearing stock or mouth-formed mouthguards. It is expected that players' difficulty would decrease if they were fitted with custom-fabricated mouthguards.

Rules do not guarantee compliance. Even with mandatory rules for mouthguards, many athletes are still not wearing mouthguards.⁵⁰ This may be due partly to a lack of appreciation by the players of the benefits of wearing

Baseball	Handball
30% reduced risk	
	Mouthguard use lowered risk; rate ratio (RR) = 0.56, 95% confidence interval (CI): 0.07 - 4.63

Coaches have the most influence on players' attitudes about mouthguards.

was presented to athletes, there was little use of mouthguards.

It appears that a previous injury has a considerable impact on an athlete's decision to wear a mouthguard compared with passively reading prevention material. Further research is needed in the area of developing prevention material that would somehow allow players to experience a virtual injury to better influence decision making.

Officials are expected to follow the National Collegiate Athletic Association (NCAA) rules that state a time-out is to be charged when a player is not wearing a mouthguard. They can also give a 5-yard penalty to a team if the limit for time-outs has been exhausted. Although there are rules in place, officials' attitudes towards mouthguard use affect enforcement. In 1993, Lancaster and Ranalli^{60,61} surveyed 109 college football officials and found that officials were unlikely to charge a time-out or to enforce penalties for mouthguard violations, even though they indicated that not all players were in compliance. Officials also reported that coaches should be responsible for player compliance. Officials believed that coaches have more influence on whether or not players wear mouthguards.

Coaches' attitudes towards mouthguard use are also an important factor in influencing players' compliance. Unlike officials, coaches are present with the players during practices and games, so would have a longer period of time during which to influence their behaviour. Coaches are also assisting players to develop consistent patterns of behaviour that should be carried forward into competition.

A number of studies show that coaches have the most influence on players' attitudes about mouthguards.⁵³ In 1995, Ranalli and Lancaster¹⁴ conducted a survey of 98 Division 1-A college head football coaches and found that they viewed themselves, the players, or the trainer as most responsible for players wearing mouthguards, not referees. Two studies on officials' attitudes towards coaches indicate that officials also believe that coaches should be accountable for athletes wearing mouthguards,¹⁴ and they believe that coaches are more influential in convincing players to wear a mouthguard.⁵³

There is some evidence that coaches are not making the best use of their influence in injury prevention. In 1998, Berg et al.⁶² conducted a survey of 508 high school athletic coaches in sports that do not mandate mouthguard use. The researchers found that 31% of coaches reported that they would not encourage mouthguard use, even if provided for free. In addition, only 13.2% of coaches reported that they offered education programs and information on mouthguard use. Somewhat more positive results are reported by Gardiner and Ranalli in 2000.⁵³ This survey of 89 coaches found that 74% of coaches would speak to the player directly if they detected a mouthguard infraction.

mouthguards. Two studies showed that only 50% of athletes thought mouthguards prevented injuries and 82% of soccer players and 26% of rugby players said that mouthguards were unnecessary.⁵⁰

Other factors that increase the athlete's likelihood of wearing a mouthguard include starting to wear a mouthguard at an early age,⁵³ a previous injury, and player position. A study of rugby⁵⁷ and basketball⁵⁵ players indicates that mouthguards were more frequently worn by those who had experienced a previous oral trauma. Some players, such as quarterbacks, may not wear a mouthguard since some find that it interferes with their ability to call signals.⁵³ Similarly, defensive hockey players, who have to talk more than offensive players, report more negative attitudes toward mouthguard use.⁵⁸

Two studies show that promoting injury-prevention material had little impact on whether or not a player wore a mouthguard. In 2003, in Australia, Cornwell et al. conducted a study of 496 basketball players.⁵⁵ They measured mouthguard wearing prior to and following a promotional intervention. Baseline mouthguard use was 62% at games and 25% during training. Although 90% of athletes acknowledged the protective value of mouthguards for basketball, youths after the intervention, did not increase mouthguard use, and adults increased their use by only 14% for training and 10% at games. Players who had previous injuries were 2.76 times more likely to wear mouthguards. In a similar 2002 study, Ferrari and Medeiros surveyed 204 professional and semi-professional athletes⁵⁹ and found that although mouthguard prevention material

Parents' decisions about mouthguard use also affect mouthguard utilization, since they have decision-making power in children's activities. In 1997, Diab and Mourino⁶³ conducted a survey of 1,800 parents with grade school children and found that three fourths of parents had received no information on mouthguards and injury. There was a lack of perceived need for mouthguards in sports such as basketball, baseball, and soccer, even though these are sports with the most frequently reported injuries.

Despite the evidence for the efficacy of mouthguards and the mandatory regulations and positive attitudes about mouthguards in some sports, there is not always compliance amongst athletes. In addition, coaches and referees are not always promoting or enforcing mouthguard use. These barriers to prevention may be addressed with educational information about orofacial injuries and the benefits of mouthguards which targets players, officials, coaches and parents. One of the educational program's goals should be to change athletes'/parents' behaviour, so that it is proactive instead of reactive.

EVIDENCE FOR MOUTHGUARD EFFECTIVENESS

A number of reviews of epidemiological and laboratory studies show that mouthguards reduce orofacial injuries. The first review (eight studies of the years 1968 to 1992⁶⁴) showed mouthguards unequivocally reduce hard and soft oral tissue injuries, jaw fractures, and neck injuries. A second review, which included three other research studies, also documented the substantial impact that mouthguards have on reducing sports-related orofacial trauma.² A third review of four surveillance-based research studies showed that mouthguards are effective in preventing dental injuries.³³

Mouthguards unequivocally reduce hard and soft oral tissue injuries, jaw fractures, and neck injuries.

A fourth review (12 studies) stressed the protective value of mouthguards. Within this review, only 1 of these 12 studies found no protective value. Unfortunately, more than half of these studies were conducted between 1968 and 1986, and only three were conducted more recently, i.e., 10 years ago. The age of the studies calls into question their validity since statistical analysis techniques have changed significantly over the last 15 years. Further efficacy information is presented in table 3, which documents a number of individual studies.

There are some gaps in the existing research, showing a need to conduct randomized controlled mouthguard trials in the field. A recent review of the literature indicates that studies in craniomaxillofacial injury prevention lack high-quality scientific design.³³ The study designs were limited by the small number of studies that included interventions (26%), controls (33%), and randomization (17%).

Marshall et al.⁶⁵ also raise some questions about the quality of studies. They note that, apart from seven cross-sectional studies that provide a weak basis for causal inference, there are only three studies with quasi-experimental or observational designs. Two of the three studies showed that mouthguards have a positive impact and the third shows no impact.

Public awareness of sports concussions has increased recently as the media reports the devastating impact on athletes who are forced into early retirement. Early studies showing the efficacy of mouthguards in preventing concussion took place in 1964 with several case reports⁶⁶ and in 1967⁶⁷ with an *in vitro* study. Heintz in 1979 also found evidence of efficacy for properly fitted mouthguards.⁶⁸ Unfortunately, these studies can be challenged because of the limited numbers of subjects and the lack of a clear correlation⁶⁹ between the factors studied and concussion.

There is still a lack of solid evidence 26 years later that mouthguard use reduces the incidence and severity of concussions. The Canadian Academy of Sport Medicine (CASM) conducted a systematic review of the literature on the topic of mouthguards and concussion and found that the evidence for prevention of concussions is poor. On one hand, they found four studies suggesting a possible benefit; however, on the other hand there are three studies that failed to show any benefit.⁷⁰ A second review of the literature by Echlin et al. in 2005 reaches a similar conclusion. Their review included three different studies, one of which was a very large study with a total of 506,297 athletic exposures. They conclude that the claim that mouthguards prevent mild traumatic brain injury is "controversial and not based on appropriate evidence based studies."⁸³ A third review is conducted by Padilla who found no data to support stock or mouth-formed mouthguards for concussion prevention.³² Other authors, such as Piccininni, have come to a similar conclusion and caution oral health professionals against making an unsubstantiated claim regarding the prevention of concussion with mouthguards.³²

Some evidence calls into question the importance of orofacial trauma in concussion. One study shows that a blow to the jaw is responsible for only 1.6% of concussion;⁶⁹ another study⁷⁰ indicates that the use of the upper extremity or the head, and not a blow to the mandible, was most likely to cause a head or neck injury, including concussion. The literature reviews combined with the etiological evidence indicate that one should be cautious when making a claim that mouthguards prevent concussion.

Although many questions remain in terms of the efficacy of mouthguards in preventing or reducing concussions, some researchers have speculated about the mechanisms for the action of the mouthguard in reducing the incidence or severity of concussion. See Appendix D for three proposed mechanisms of action.

These reviews of mouthguard efficacy suggest a pressing need for further research. The draft Pan-Canadian Injury Prevention Strategy⁵¹ makes three recommendations for increased research and programs. First, it calls for the fed-

eral government to establish a \$30 million annual National Injury Prevention Community Fund to support community-level programs to prevent injuries. Second, it calls for the establishment of a strategic injury research agenda, and a partnership between a newly developed Injury Prevention Centre of Canada and the Canadian Institutes of Health Research (CIHR) to co-fund injury prevention team development grants at \$100,000 annually. Third, it recommends the establishment of a \$4 million annual injury research and demonstration fund to test and evaluate injury prevention and control approaches.

THE ROLE OF THE DENTAL HYGIENIST

Dental hygienists obtain educational information on mouthguards through studies for a university bachelors degree, a college diploma, and continuing education programs. This information includes, but is not limited to, assessing the needs of the client for mouthguard protection, fabrication of the mouthguard, and educating the client on the use of a mouthguard. The 2005 Blueprint for the National Dental Hygiene Certification Board exam includes competencies pertaining to mouthguards—a testament to the importance of this topic in dental hygiene education. Dental hygienists who familiarize themselves with the different types of mouthguards and the advantages and disadvantages of each type are better prepared to reinforce their use with clients.

Dental hygienists are well positioned to help prevent injuries by changing clients' attitudes toward mouthguard use. While providing information on oral disease prevention and oral health promotion, dental hygienists can seize opportunities for simple interventions. They can teach their clients about the risks for dental trauma in sport and about the importance of protecting their teeth with a mouthguard. A conversation about the clients' hobbies and interests can incorporate educational information about the preventive nature of mouthguards. Reducing risk of orofacial injuries in sports is another piece of educational information that should be presented to clients who engage in sports at both the recreational and competitive levels. The "Information Sheet for Dental Hygiene Clients: Mouthguard Use and Care" at the end of the article can help in providing advice on the use and care of properly fitted mouthguards.

Dental hygienists can promote mouthguards and make them in a number of different settings including independent dental hygiene businesses, mouthguard clinics at schools and at sports arenas, dental clinics, community health centres, and public health. Reaching out to the community through clinics and private businesses helps to make mouthguards more accessible and affordable. The average cost for a mouthguard made in a dental office in Canada is between \$100 and \$135.^{70,71} Studies from the United States show similar costs that range from US\$82.96 to US\$150.^{2,72} Dental hygienists in Ontario and Saskatchewan with private mouthguard businesses make mouthguards for a fee of \$35 to \$50.⁷³

Some examples of dental hygienists who fabricate mouthguards follow. One dental hygienist in Ontario pro-

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vides mouthguard clinics, working mainly with hockey, lacrosse, rugby, baseball, and basketball associations. The clinic involves taking impressions on site at the arena, answering questions, and giving demonstrations. One dental hygienist in Saskatchewan takes the impression in the client's home, fabricates the mouthguard in his home lab, and delivers the mouthguard to the client within one week. This dental hygienist makes mouthguards for a variety of sports, concentrating on hockey and lacrosse, and for disabled children as store-bought mouthguards often do not fit properly. As a public service, this dental hygienist also makes presentations to athletes, coaches, and parents on the different types of mouthguards and the importance of their use. Dental hygienists across Canada who make these types of presentations at team meetings, schools, and clubs such as the Boys and Girls Club are making an important contribution to primary prevention.

Some dental hygienists work with dentists to provide mouthguards to the public. Over the past five years, one Manitoba dental hygienist and dentist run mouthguard clinics with junior hockey team and with the North American Indigenous Games. Some dental hygienists are advocating for legislation changes to remove restrictive supervision by dentists that prevents them from opening up their own mouthguard business. Dental hygienists in Newfoundland and Labrador expect to celebrate success in this area: legislation expanding the scope of practice to allow dental hygienists to construct mouthguards soon will be presented to the Minister of Health. There is more resistance in Quebec where existing legislation prohibits dental hygienists from taking alginate impressions.

Although a greater number of dental hygienists work in independent practices now than in the past, the majority of dental hygienists still work in a team environment with other oral health professionals and general health professionals. Part of this teamwork involves collaborating on service provision, including mouthguard education and fabrication. A study conducted in 1999⁶⁴ examined the attitudes of dentists towards mouthguard protection. This study found that 97% of orthodontists and 67% of general dentists recommended mouthguards for their clients. The two main reasons for not recommending a mouthguard were (1) that a less expensive mouthguard was available over the counter, and (2) the dentist/orthodontist did not receive formal training on fabrication or use of mouthguards.

A similar study conducted in 1998 found that only one third of dentists indicated that dental school taught mouthguard fabrication, 13.8% said they learned in a continuing education course, and almost 40% were self-taught.⁷² In addition, many dentists questioned whether they were the oral health professionals who were responsi-

ble for distributing and fabricating mouthguards. A lack of involvement by oral health professionals is confirmed in a 2004 study by Pribble et al.⁷⁴ who conducted a survey of 120 parents of children participating in competitive soccer. This study found that very few health professionals recommended mouthguards for young athletes. Although some dentists' involvement in injury prevention may be limited, others are strong advocates of mouthguards. For example, the Academy of Sports Dentistry formed in 1983 and now has an international membership of over 800 members who take an active role in promoting mouthguard use.

Dental hygienists also incorporate mouthguard issues into in-service presentations to nursing staff at community health centres. They incorporate injury prevention and mouthguard material into other oral health topics such as fluoride use, oral cancer, and the link between general health and oral health. A U.S. research project substantiates a need for increased work in this area. The study examined primary care nursing centres⁷⁵ and found that, although almost half of nurses examined their clients for gum infections and oral lesions, only 15% educated clients about mouthguards. In addition, the majority do not refer clients to oral health professionals for treatment of dental decay or oral pain.

Public health dental hygienists offer population-based intervention programs to parents, coaches, players, and officials of organized sports. These programs educate the listeners about the risk of injury, the benefits of mouthguards, and encourage the enforcement of rules of play. A systematic review of population-based interventions was conducted in 2002 by Truman et al. to examine increases in the use of mouthguards and decreases in sport-related craniofacial injuries attributable to the intervention.^{20,76} This review examined 17 studies and found that 13 could not be included in the review due to design flaws and 9 of the 13 were also not admissible because of the lack of appropriate effect measure. The remaining 4 studies of fair quality did not provide sufficient evidence to determine the effectiveness of population-based intervention to encourage mouthguard use. Effectiveness could not be determined because of inadequate number, design, or execution of studies.

This does not mean that population-based interventions are ineffective but indicates a need for additional research and evidence to allow a judgment about this intervention.

CONCLUSIONS

Research shows that orofacial injury in sport is prevalent and carries significant medical, financial, cognitive, psychological, and social costs. Research also confirms that mouthguards can prevent orofacial injuries. The CDHA therefore strongly recommends that dental hygienists play an integral role in the prevention of orofacial injury in sports and promote properly fitted mouthguards as an essential piece of protective equipment, in sports that present a risk of orofacial injury at the recreational and competitive level.

Relatively few Canadian organizations take a stand on the use of mouthguards compared with American organizations. The Canadian Dental Hygienists Association's strong stand on the use of mouthguards as primary prevention for orofacial injuries places CDHA as a Canadian leader in this area. There is significant opportunity for dental hygienists to protect the health and safety of children and adults in sport by supporting and promoting mouthguard use. It is not just the fastest and roughest sports such as football, rugby, and ice hockey that result in orofacial injury. Sports that are considered less dangerous such as soccer, baseball, field hockey, and basketball also have the potential to cause orofacial injury.

There is compelling evidence indicating that mouthguards can make sport safer by preventing orofacial injuries. The evidence for the role of mouthguards in preventing or reducing the severity of concussions is very weak and further research is needed in this area. Custom-fabricated mouthguards, particularly the pressure-laminated type, appear to provide a number of benefits over other mouthguards: the thickness can be adjusted for specific sports; it can be extended to the second molar; and the mouthguards can be articulated against the mandibular model.

Some progress has been made in preventing orofacial injuries since the 1960s and 1970s when mouthguards first became mandatory. However, there is still considerable work to be done in developing more positive attitudes and increasing use of mouthguards. First, greater use of mouthguards in all contact sports needs to be promoted. The cost of a mouthguard fabricated by oral health professionals is extremely low compared with the medical, financial, cognitive, psychological, and social consequences associated with orofacial injury. Second, a multidisciplinary approach is needed to increase the number of players who wear mouthguards. The coach, officials, parents, dental hygienists, other oral health professionals, and general health professionals all have a role to play. They can help the public to develop positive attitudes to mouthguard use, influence behaviour, and address compliance issues in sports where mouthguards are mandated. Third, there is a need to develop an approach for expanding regulations regarding mouthguard use in sports.

Unfortunately, Canadian statistics on incidence of orofacial sports injuries are limited and may be underreported due to the lack of a national surveillance system. This gap in knowledge may be addressed by the creation of an Injury Prevention Centre of Canada. Such a centre could coordinate surveillance and maintain a database of orofacial injury reports. This information could be used to study the efficacy of mouthguards, assist in designing better mouthguards, and promote better public education.

RECOMMENDATIONS

Dental hygienists can

- work together with other health professionals to deliver health education, injury prevention, and mouthguard promotion campaigns on either a one-to-one basis or to groups of clients, parents, athletes, athletic teams, sports coaches and officials, and gym teachers;

- act as change agents to influence a culture in sports that accepts mouthguard use as a normal part of dressing for sport;
- fabricate mouthguards and advise on the use and care of properly fitted mouthguards;
- conduct research on the oral health promotion of mouthguards and the prevention of injury.

Sports governing bodies, local injury prevention centres, and school districts can

- mandate the use of properly fitted mouthguards during practices and competition in all sports where orofacial injury is a risk, including sports such as basketball, baseball, and soccer;
- develop a plan to address compliance in sports that mandate mouthguards;
- deliver increased health promotion and education of athletic trainers, coaches, sports officials, organizers, administrators, athletes, and parents.

Dental hygiene professional organizations and educational institutions can

- work with national sports and school organizations to develop an approach for expanding mouthguard regulations in sports and for addressing compliance issues in sports that have existing mouthguard rules;
- provide ongoing opportunities during college/university and in continuing education to gain knowledge and experience with mouthguard issues.

Governments can

- fund health promotion and injury prevention programs that include mouthguards;
- work with local or provincial injury prevention centres to establish an Injury Prevention Centre of Canada (IPCC), which would be responsible for an injury surveillance system, monitoring injury exposure and inci-

- dence, and assessing injury trends in activities when new equipment or regulations are introduced;
- establish an injury research and demonstration fund to test and evaluate injury prevention and control approaches.

Health insurance industry can consider covering the cost of properly fitted mouthguards in health plans and promote the use of custom fabricated mouthguards.

Researchers can conduct high-quality mouthguard research, including randomized controlled trials on topics such as:

- efficacy of various types of mouthguards in preventing orofacial injuries and concussion;
- cost-effectiveness of mouthguards and infection control;
- effectiveness of population-based interventions and sports regulations, including an increased penalty severity for mouthguard rule infractions, for increasing mouthguard use;
- survey dental hygienists and other oral health professionals to determine the general knowledge and experience levels with respect to mouthguards and to determine attitudes of dental hygienists with respect to advocating for mouthguard use;
- improved product design of an effective, comfortable mouthguard that would facilitate widespread compliance.

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APPENDIX A METHODOLOGY

The methodological approach in this paper is a comprehensive review of the literature on mouthguards, orofacial injury in sport, mouthguard efficacy in preventing orofacial trauma, and the role of the dental hygienist in promoting injury prevention and preventing orofacial injury. The methodology included the development of specific research questions for each section of the paper. These questions were then used to develop search terms for the literature search.

The researcher conducted a detailed search of relevant international English language literature from 1995 to 2005 using MedLine, CINAHL (Cumulative Index of Nursing and Allied Health Literature), and the Cochrane controlled trials register. In vivo and in vitro studies were included in this review. The keyword search included the terms dental hygienist, mouthguards, mouth guards, mouth protectors, occlusal splint, athletic injuries, sports injuries, orofacial injury, tooth injury, tooth fractures,

brain injury, statistics, incidence, sports, and athletics. The search strategy also used the clinical queries research methodologies search filter, using categories that included systematic reviews, meta-analysis, randomized controlled trials, and review, with a specificity of narrow scope.

The search also included “gray” literature—information not reported in the scientific periodical literature—and web sites known to contain publications on this topic. In addition, references cited in the articles were searched manually as opposed to a computer database search. Recognized experts in the topic area were consulted and asked to comment on the outline and corresponding literature so they could identify relevant articles that might otherwise have not been identified. They were also asked to comment on the draft paper. Members of the Canadian Dental Hygienists Association also provided comment on the draft paper.

APPENDIX B WORLD HEALTH ORGANIZATION TOOTH INJURY DEFINITIONS⁸⁸

Avulsion	A complete displacement of a tooth from its socket
Chipped	A complete fracture and displacement of a portion of the tooth
Concussion	Tooth is sensitive to percussion but not displaced or abnormally mobile
Fracture: crown	Fracture of enamel and dentin; may or may not involve exposure of pulp
Fracture: enamel	Fracture of enamel only and includes chipping, cracking, and incomplete fractures
Fracture: root	Fracture of root only
Luxation: extensive	Tooth is very mobile because of partial displacement out of its socket
Luxation: intrusive	Tooth has been forced down and embedded into bone
Luxation: lateral	Tooth has been displaced and may be very firm
Subluxation	Tooth has increased mobility but has not been displaced

APPENDIX C CATEGORIES OF OROFACIAL INJURIES⁴⁹

Soft tissue injuries

- These include contusions or lacerations to the lips, tongue or gingiva, as well as dislocations or trauma to the temporomandibular joint, bruising to the facial muscles, nerves, fascia, and blood vessels.

Dental injuries

- These include chips or minor, moderate or severe fractures, tooth luxation, avulsions.
- There may also be trauma to the ligaments or trauma/concussion to the tooth where the tooth is not moved out of position.

Bony injuries

- These include minor fractures to the alveolar bone and facial bones.

Other injuries

- These include aspiration of teeth or other dental prostheses, and cerebral concussions.
-

APPENDIX D MECHANISMS FOR THE ACTION OF THE MOUTHGUARD

Researchers propose three mechanisms for the action of the mouthguard in reducing the incidence or severity of concussion. These views, however, are speculative and research is needed to substantiate the theories.⁶⁶

1. Opening the condylar space^{32,49,66}

The mandibular condyle of the jaw fits into the skull at a structure called the trough of the mandibular fossa. The mouthguard opens up the space between the condylar head and the mandibular fossa, of the temporal bone. This space decreases the force delivered to the temporal area of the head by preventing the condyle of the mandible from being driven into the fossa.

2. Dissipation of forces^{2,32,89}

Mouthguards absorb the energy from a blow to the head, chin, and face and dissipate the upward force and remaining energy to the jaw across the entire mouthguard, thereby reducing trauma to the brain and skull. Mouthguards cushion the shock from a blow to the jaw and prevent the transmission of the shock through the temporomandibular joint to the skull.

3. Reduction of rotational forces^{32,49,90}

A blow to the inferior aspect of the mandible is transmitted through the midfacial skeleton, forcing the skull to rotate backwards. The mouthguard allows the user to exert a clenching force with the head and neck muscles, which stabilizes the skull and reduces the jarring of the brain.

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Mouthguard Use & Care



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

- Mouthguards are for recreational, professional, or competitive athletes and should be worn in practices as well as games.
- Initially wear the mouthguard during training or practices in order to adapt to the new feel of the guard in the mouth.
- Do not chew on or alter the mouthguard as this will affect the fit and possibly damage it or decrease its effectiveness.
- Custom-made mouthguards are made for that particular time when the cast of the dentition is taken.
- It may be easier to find a lost mouthguard on the playing field if it is coloured plastic, rather than clear.
- Rinse the mouthguard with cold water or with a mouthrinse before and after each use. Avoid contact with hot water.
- Since the mouth contains bacteria and plaque, it is important to clean your mouthguard after each use. Clean it with toothpaste and a toothbrush or clean it in cool, soapy water and rinse thoroughly.
- Store and transport the mouthguard in a firm, perforated container to prevent damage and permit air circulation. Do not close the mouthguard container until the freshly washed mouthguard is dry.
- Do not share your mouthguard with others.
- Avoid high temperatures or direct sunlight to minimize distortion.
- Check the condition of the mouthguard occasionally and replace it if it has holes or tears, becomes loose, or irritates the teeth or gums.
- Remove retainers and other removable appliances such as orthodontic retainers, removable bridges, or dentures (complete or partial) before inserting the mouthguard.
- If the mouthguard absorbs a strong blow, it may need to be replaced to maintain a proper fit and protection.
- Due to pressure from the teeth, and alternate wetting and drying that occur between uses and during cleaning, mouthguards wear out over time. The material deteriorates and loses resilience, reducing effectiveness. Therefore, they should be replaced every two to three years. Earlier replacement is recommended if they become cracked, torn, and split, or if fit deteriorates, significant wear appears, or there is unsatisfactory retention.
- Bring the mouthguard to each dental hygiene visit to have it evaluated by the dental hygienist.





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START A CONVERSATION, SAVE A LIFE

As a dental hygienist, you have a key role to play in helping clients quit tobacco. With just two minutes of conversation, you could quite literally save a life.

But how do you bring it up? It's uncomfortable to talk about, we know. That's why the CDHA and Health Canada are developing the online continuing education course *Tobacco Cessation: Strategies and Techniques*. It provides

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BRISER LA GLACE

pour que vos clients puissent perdre l'habitude de fumer

EN ABORDANT LE SUJET, VOUS POURRIEZ SAUVER UNE VIE!

En tant qu'hygiéniste dentaire, vous avez un rôle clé à jouer en aidant vos clients à renoncer au tabac. En leur parlant deux minutes, vous pourriez littéralement leur sauver la vie.

Mais comment aborder le sujet? Nous sommes conscients qu'il est difficile d'engager la conversation en ce sens. C'est pour cette raison que l'ACHD et Santé Canada travaillent à l'élaboration d'un cours de formation professionnelle continue en ligne *Renoncement au tabac : stratégies et techniques qui englobe* :

- les 5 consignes clés du renoncement au tabac (questionner, conseiller, évaluer, appuyer et assurer un suivi)
- l'entrevue motivationnelle (surtout pour les personnes qui résistent au changement)

Vous recevrez également de l'information sur la chimio-dépendance, les symptômes du sevrage de la nicotine, les façons d'évaluer la consommation individuelle de tabac et de reconnaître les étapes de la transformation pour déterminer si la personne est prête à cesser de fumer. Prenez note que le cours sera offert sur le site web de l'ACHD réservé aux membres dès la mi-janvier 2006.

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Sustaining Proficient Practice through Continuing Education: Perspectives of Dental Hygienists

by Brenda K. Udahl,* SDT, RDH, BV/TEd, MHRD

ABSTRACT

This study investigates the relationship between maintaining clinical competence and continuing education in the practice of dental hygiene. Six dental hygienists with a minimum of five years' experience who had just completed a continuing education reporting period participated in the study. Dental hygienists who practise in both rural and urban areas of Saskatchewan were represented. In a focus group interview, participants were asked to describe a competent dental hygienist, how individual dental hygienists maintain competency, and how continuing education activities contribute to that competency.

The findings, discussed in light of current literature on continuing competency and continuing education, indicate that interpersonal and self-assessment skills are critical components of competent dental hygiene practice. Dental hygienists use self-assessment daily to determine areas of their individual practices that require attention to maintain proficiency. Continuing education activities applicable to settings in which individual dental hygienists practise are useful to remedy self-identified deficiencies.

The importance of teaching self-assessment skills in pre-professional education and of ensuring that continuing education activities have a mode for transferring learning into practice has implications for the dental hygiene profession. The study concludes with recommendations for further study arising from the findings. Further research is required to investigate the effects of continuing education on client outcomes and the reliability of self-assessment.

Keywords: clinical competence; education, continuing; quality assurance; qualitative research

INTRODUCTION

OVER THE PAST DECADE, DENTAL TECHNOLOGY AND the dental hygiene knowledge base have seen sweeping changes that challenged dental hygienists to keep informed about new methods, materials and consumer products. Continuing education programs can help dental hygienists incorporate the new knowledge, skills, materials, and technologies into their current practice. Many types of programs exist to provide continuing professional education. Saskatchewan has chosen mandatory continuing education—requiring a dental hygienist to attend continuing education activities in order to qualify for a licence—as the vehicle to ensure client safety.¹ This study explored (1) how dental hygienists choose continuing education activities to attend, and (2) how these activities, in the opinion of dental hygienists, are then translated into improved clinical practice.

LITERATURE REVIEW

Continuing education is a planned, organized learning experience intended to enhance previously learned knowledge, skills, and attitudes or to provide new content to meet career goals.² Health professions in all 50 states of the United States use mandatory continuing education as a basis for re-licensing members.³ In Saskatchewan, the licensing bodies of the Saskatchewan Dental Hygienists'

Maintaining a competent practice requires further learning once a course of study is completed.

Association (SDHA), College of Dental Surgeons, Saskatchewan Dental Assistants' Association, and the Saskatchewan Dental Therapists' Association require mandatory continuing education. Members of the dental hygiene profession generally view mandatory continuing education positively.^{4,5} However, nursing in some states has resisted mandatory continuing education because the nurses believe there is no established link between increased positive outcomes and continuing education. Only one state has reported a decrease in disciplinary actions since implementing mandatory continuing education.⁶

Maintaining a competent practice requires further learning once a course of study is completed. In science-based professions, what was learned at graduation may be outdated within 10 years.⁷ Society rightly expects a professional to maintain current knowledge and skills,⁸ and it is assumed that participation in continuing education activities translates into provision of quality care. Several studies have investigated the connection between continuing education activities and the retention/renewing of skills and knowledge possessed at graduation.^{9,10} In the first study, conducted to determine why dental hygienists

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attend continuing education activities, Body found that 86% of 195 Ohio dental hygienists believed that attending continuing education activities increased the quality of the dental hygiene care that they provided.⁹ However, in a more recent survey of perceived continuing education needs of dentists in Alberta, Sandilands concludes that a “lack of consensus regarding the role of CPE (Continuing Professional Education) in changing practice and enhancing competence was evident”¹⁰ (p. 97). In order to illuminate the connection between activities and maintaining competence, Sandilands recommends continuing education offerings be changed from the review of previously learned concepts to having participants actively engage in learning. Cervero echoes this recommendation, saying that continuing education should be integrated into individual and collective practice.¹¹

The most common tools used to measure continued competence appear to be self-assessment and peer review.

Difficulties in assessing continued competence start with the concept of competence itself. Low and Kalkwarf describe professional competence as “the ability to use knowledge, skills and judgment associated with the profession to perform effectively in the domain of possible encounters defining the scope of dental practice”¹² (p. 385). This description suggests that competence depends on the situation. Milgrom et al. relate that continuing competency is used as a synonym for quality assurance and implies that the individual remains current and possesses sufficient skills.¹³ In the dental hygiene field, Pimlott et al. describe competence as the ability to perform technical tasks skillfully, while Chambers and Gerrow describe a competent practitioner as one who is able to function in context.^{14,15} This last description introduces a situational dimension to the concept of competence. Abruzzese claims that competence without productivity is useless.¹⁶ Del Bueno believes that measurement of competence, to be operational, must be specific to the setting.¹⁷ The above discussion shows that the skills must be measured, yes, but the circumstances surrounding the application of those skills must also be considered.

The most common tools used to measure continued competence appear to be self-assessment and peer review.^{4,12,18} Practice audits and case presentations have also been used in dentistry to a lesser extent.^{8,12,18} Both professions of dental hygiene and dentistry have proposed peer review as a means of quality assurance.^{19,20} Fried et al. found that dental hygienists in Maryland value self-assessment and use it daily as a means of quality assurance.²⁰ Brothwell states that peer review can be advantageous in ensuring quality of service.¹⁹ Waddell found that peer review and a systematic self-assessment incorporated into annual performance review provide nurses with the best opportunity to assess and improve their practice.²¹

Furthermore, she claims that self-assessment supports the concept of individual professional accountability for maintaining continued competence. Houle includes peer review and self-assessment as one of the three frames of reference for evaluating continuing professional learning.²²

Forrest outlined the need for both self-assessment and peer review skills to be taught and practised in dental hygiene schools.²³ Their inclusion in a curriculum is especially important as the American Dental Hygienists' Association has adopted guidelines for peer review and standards of practice.²⁴ Forrest found that fewer than 44% of dental hygiene graduates reported engaging in peer review activities, and fewer than 66% recalled being taught self-assessment skills while in school. In light of the reliance on self assessment and peer review to measure competence, the concepts must be included in the dental hygiene knowledge base.

Recently, continuing education programs have been expanded to provide quality assurance. Asadoorian describes quality assurance programs as those activities that promote the advancement of the profession as well as ensure competence.⁴ The importance of quality assurance in the dental hygiene profession cannot be overestimated. Asadoorian suggests that consumers of dental hygiene care have limited ability to judge the quality of technical skills, and poor quality hygiene care can affect overall health. Pimlott et al. promote quality assurance programs as being meaningful for the dental hygiene profession, because such programs reflect a concern for the needs of consumers and demonstrate a commitment to providing quality care.¹⁴ Forrest states that quality assurance activities are inherent in a profession, and the field of dental hygiene should not be an exception.²³ Dental hygienists in Canada have formally discussed quality assurance since developing practice standards in 1985. In fact, the definition and application of practice standards by a profession are an essential part of quality care.²⁵ However, Asadoorian found that the practice standards for dental hygienists in Canada are underutilized in quality assurance programming.⁴

The studies referred to above have investigated various methods that professionals may use to continue their professional education and to ensure continuing clinical competency. Self-assessment is the predominant measurement tool, but the opinions of peers are also valuable in assessing practice. However, further research is required to ascertain how continuing education activities actually translate into improved practice.

MATERIALS AND METHODS

A qualitative approach was used to examine the relationship between competence and continuing education of dental hygienists in Saskatchewan in order to elicit data that had not been obtained in previous surveys relating to continuing education in the dental field.^{5,10,26} Qualitative research is designed to be an interpretive process that is shaped by the researcher's personal history, gender, and biography.²⁷ The product is a combination of both the

researcher's and participants' interpretation of the phenomenon under study.²⁷

Two qualitative research genres, ethnography and phenomenology, are represented in this paper. The culture of dental hygiene influenced all aspects of the research, resulting in a partly ethnographic work. Phenomenology is also present in that the research explored the experiences of a small group of dental hygienists.

Rigour was achieved by collecting sufficient data to provide saturation and variation.²⁷ In this study, the researcher facilitated the focus group interviews and was able to ensure that the participants completed their discussions on each question. Variation was obtained by including participants who had graduated from different dental hygiene schools and who had practised for a different lengths of time in different locations. Notes, jottings, and drafts were kept in a chronological file to provide an audit trail. The participants verified the data, another way of ensuring rigour.

A focus group interview was used to gather the data. The focus group format was chosen for several reasons. First, it is a qualitative research technique useful for gathering opinions and perceptions—the types of data sought to answer the questions in this study—to complement the quantitative data obtained in previous studies.^{5,10,26} Second, participants' responses can be clarified immediately and explored for further understanding.²⁸ This would have been more challenging with written survey data. Third, a discussion format with several people can elicit richer data than individual interviews because more views may be presented and participants can build on one another's examples. However, focus groups may tend to be dominated by more assertive individuals. In addition, participants may agree in order to preserve harmony within the group. To prepare the participants to contribute fully, each received an agenda that included the main discussion topic areas prior to the focus group meeting day. To provide structure for the focus group discussion, questions were developed that related to a description of competency, continued competency, and the relationship between these concepts and continuing education. The questions were pilot tested prior to being included. The focus group discussions were both taped and video-recorded to ensure no data would be lost.

A random sample for the study was chosen from those dental hygienists that (1) had completed a three-year continuing education reporting period on December 31, 2001; and (2) had five or more years of experience. It was thought that their reflections relating to continuing education would be more relevant if they had recently participated in some activities; this would probably have occurred as they had just completed a reporting period. Dental hygienists from both rural and urban locations were included because the distance that people must travel to attend continuing education activities has been cited as a factor that influences participation in those activities.^{7,29,30} For the purposes of this study, and following the distribution of dental practices in Saskatchewan, a rural setting was defined as one that was outside Regina or

Saskatoon. The focus group ultimately consisted of six dental hygienists. Four were from rural areas and two were from Regina and Saskatoon.

Bias is inherent in qualitative research. In fact, it often drives the research.²⁷ In this study, the researcher is an instructor in the Dental Hygiene Program at the Saskatchewan Institute of Applied Science and Technology (SIASST), has served as Acting Program Head, and is a past president of the SDHA and a former Chair of the Continuing Education Guidelines Committee. She has therefore a direct interest in the concept of competent dental hygiene practice, as well as in the effectiveness of continuing education as it contributes to competence. The bias was addressed prior to the focus group interview. The research questions were carefully composed, so they did not appear to be “leading” questions.

The University of Regina Research Ethics Board approved this study. Each participant chose a pseudonym so that his or her identity would remain confidential and the participants consented, in writing, to take part. Permission to contact its members for the study was also granted from the SDHA.

RESULTS

The researcher began by organizing the data into three broad categories corresponding to the three issues that were discussed: competence; learning since graduation; and continuing education. Inductive and deductive logic principles were used to search for recurring patterns and language. The transcript was also reviewed for unexpected comments, opposing views, or alternative understandings that may have existed.

The focus group first generated descriptions of a competent dental hygienist. The group then separated the qualities into those a dental hygienist should have on the first day of work, and those that are gained more or less through experience. They stipulated that a confident and caring attitude was essential to competent dental hygiene practice, in fact declaring that attitudes and values were more important than exceptional clinical skills. The qualities are shown in table 1.

Initial qualities	Acquired qualities
Professional appearance	Confidence
Sincerity	Organization
Caring nature	Self-assurance
	Professional clinical skills
	Professional conduct

Table 1. Initial and acquired qualities of a competent dental hygienist

The participants listed successful completion of a dental hygiene program, self-assessment, remaining in the practice of dental hygiene and employer, co-worker and client satisfaction as indicators of competent practice.

Participants next described how they personally keep their practice current and how they personally ascertain

View at graduation	Change in perception
DHs focus on the oral cavity.	DHs contribute to overall health.
Treatment plans are prepared, based on clinical data.	Care plans integrate clients' values and attitudes.
Level of instrumentation skills dictates the success of treatment.	Comprehensive care influences treatment.
Perfect hygiene care means resolution of inflammation.	Many factors contribute to health.
DHs make a treatment plan.	DHs make a care plan.
DHs have learned state-of-the-art skills.	DHs continuously learn new skills and knowledge.
DHs provide instrumentation skills.	Communication, teamwork, and interpersonal skills are also required to be successful.

Table 2. Changes in dental hygiene practice since graduation

that they are competent. In keeping with the general theme that had been established, the first comment was “If you have a soul, you care.” They believed that reading current journal articles and participating in discussions with colleagues were important activities that could trigger a desire to learn; supporting these activities were the elements of enthusiasm and experience. It was noted that careful thought and experience are needed to distinguish between new practices that are evidence-based and those that may be experimental, or to quote the participants: “You’re not going to jump on the bandwagon because it’s the latest thing – you make sure it actually works and is accepted practice.” The participants agreed that the SDHA continuing education requirements were an incentive for dental hygienists to attend educational activities. However, they stated that “you also have to apply it.” This indicates that it is the application of knowledge that makes it effective and that the regulatory requirements are only the beginning to assisting dental hygienists to keep current. The discussion on competence concluded with the participants discovering that they all asked themselves the same question: “Would I want this done in my mouth?” If this could be answered affirmatively, then that became each individual’s standard of care.

Participants maintained that their individual practices had changed the most in the areas of interpersonal skills, as well as in their own attitude towards their profession. They explained that they once believed that their instrumentation skills would dazzle their clients and employers, and would result in good oral health for their clients. Now they believe that functioning effectively as part of a team contributes to the client’s and ultimately to society’s general health as well. One participant explained that “all clients are not created equal; you don’t put people into slots and you tailor the treatment to the reality of their situation.” The participants agreed that knowing more about the client’s home care situation and oral health values allows the clinician to formulate a care plan that has a greater chance of success. In addition, clients usually have more confidence in an operator who appears to be familiar with their specific case.

The next change mentioned was the perceived notion of perfectionism in dental hygiene practice. “There are limits to what you can influence” and “You don’t have to be perfect” are two comments contributing to this viewpoint.

Technological changes in clinical dental hygiene practice were the next change in practice that was mentioned. Advances in powered instrumentation and contributions to the dental hygiene knowledge base have required dental hygienists to learn to use techniques that are different from those they learned in school. For example, one participant noted that when she was in school, each student had only one chance to use an ultrasonic scaler (or “one kick at the cavatron”). She “had to learn by doing” once she graduated. None of the participants implied that this “learning by doing” was difficult, avoidable, or exceptional.

The last change that the participants discussed was their personal perception of dental hygiene practice. It was reflected in the statement, “When I graduated, I don’t think I had a picture of our profession being part of a larger health picture.” The other participants agreed that when they graduated, they limited their focus to the oral cavity. However, changes in dental hygiene practice and in the expectations of the oral health care consumer have changed their views of themselves. They now see dental hygienists as part of a team that contributes to the overall general health of the population. These changes are noted in table 2.

The last part of the session was focused on determining if a relationship existed between acquired qualities, personal changes in dental hygiene practice, and continuing education activities. The participants were adamant that people skills were critical to being a good dental hygienist, because “. . . people wouldn’t come back to you because half the time you’re doing something that they’re not really thrilled about having done.” They mentioned that the faculty of the dental hygiene program is in the best position to identify students who are weak in this area and to help them to become stronger, because it is important that dental hygienists develop those skills early. There was a

feeling that people skills could be taught within the dental hygiene curriculum: identifying situations requiring certain skills, and choosing an appropriate response. People skills can also facilitate the collaborative approach that is required to obtain a client's informed consent to a dental hygiene care plan.

DISCUSSION

The focus group interview yielded insights into dental hygienists' perceptions of competence, self-assessment, and the effectiveness of continuing education activities. The participants repeatedly emphasized that professional values and attitudes are extremely important in a competent dental hygienist. Initially, when they were asked to describe the qualities of a competent dental hygienist, the qualities of caring, confidence, maturity, efficiency, and sincerity were all mentioned before adequate psychomotor skills.

However, while citing efficiency, the dental hygienists in this study seemed to emphasize caring and confidence rather than knowledge and skills as important for a dental hygienist. The definition of a competent dental hygienist suggested by Pimlott et al. refers to an ability to perform skillfully technical tasks such as scaling and polishing.¹⁴ This difference, perhaps, illustrates the significant changes that have taken place in the field of dental hygiene as it has grown into a profession. The focus of dental hygiene care has shifted from the application of technical skills to the selection of skills, tools, and techniques that are appropriate for each particular client. Here, the element of judgment does apply. It is interesting that the dental hygienists in this study received their training at a time when the narrow definition of competence was in effect. However, it appears that with time and experience, the focus of their practice has shifted from simply using the psychomotor skills they perfected at school to applying these skills appropriately in various situations. The participants appear to think that the attitude of a dental hygienist contributes as much, if not more, to competent practice than knowledge of the field and psychomotor skills. Ultimately, the definition of competent practice that coincides most closely with the participants' own thoughts comes from the field of nursing. In this definition, Exstrom says that interpersonal and decision-making skills are ranked equally with knowledge and psychomotor skills.³¹

Some definitions of competency have a situational element—the practice setting is considered.²¹ The focus group participants discussed this element, deciding that productivity and the transfer of knowledge and skills from school to practice were necessary before a dental hygienist could be judged as competent. As the participants have experience practising in general, specialty, rural, urban, private, and community settings, it can be assumed that they believe that competence is specific to a practice setting. This assumption is in agreement with del Bueno who noted that it is difficult to measure competence without considering the practice setting.¹⁷

Regarding psychomotor skills, the participants explained that once dental hygiene students had learned

the basics in school, the skills would naturally develop over time. However, there appears to be little supporting data. Murphy suggested that it takes 10 years for a novice practitioner to develop into an expert.³² This development does not come effortlessly and requires critical reflection and day-to-day practice. Perhaps it is the judicious application of skills that requires critical reflection in order to improve, but the psychomotor skills themselves remain as routine practices.

Continuing competence, the maintenance of skills and knowledge over time, has become important in the science-based professions because the knowledge base continues to change rapidly.³³ In addition, a recent survey of practising dental hygienists in Saskatchewan found that over 50% had more than seven years of experience.³⁴ Therefore, in the years of practice since graduation, the majority of dental hygienists have been challenged by changes in methods, materials, and dental products. The dental hygienists in the focus group were no different. The dental hygienists thought that modifying one's practice was a normal occurrence and again cited "professionalism" as the impetus behind making changes.

Participants maintained that their individual practices had changed the most in the areas of interpersonal skills, as well as in their own attitude towards their profession.

A significant portion of the literature on continuing competence noted that *measuring* competence was still an unresolved issue.^{12,21} Difficulties in this regard were also apparent in the focus group interviews. The participants were adamant that interpersonal relations and professional conduct should be present in a practitioner but found it quite a challenge to identify valid and reliable tools to measure those qualities.

The participants agreed that the faculty in dental hygiene programs were responsible for ensuring that graduating dental hygienists were competent to practice. They also agreed that experienced dental hygienists should have developed sufficient self-assessment abilities so as to be aware of ineffective practice; the participants believed that clients were also capable of assessing a clinician's skills. This view differs from that of Asadoorian who states that consumers have a limited ability to assess technical dental hygiene skills.⁴ Participants believed that satisfactory professional values and attitudes could be measured by the years spent in practice. The participants explained that dental hygienists who were not competent would not be content in their professions and would leave early to find a new profession.

In agreement with the literature, the participants relied on self-assessment to measure competency.^{18,20} Although

Forrest found that many dental hygiene schools did not teach self-assessment skills, the dental hygienists in this study did not mention this lack as a problem.²³ Perhaps this can be explained by Murphy, who stated that expert practitioners internalize standards so well that they automatically self assess.³² Similar to the nursing profession, the participants stressed professional accountability for maintaining competence.²¹ None of the participants mentioned peer review as a measurement tool.

In this study, the participants discussed competency as an individual responsibility. They did not continue the discussion to consider the effect of that individual competence on the profession of dental hygiene as a whole. However, Houle cites advancement of the profession as a goal that can be attained by continuing education.²² In the health professions, continuing competency is a component of a quality assurance program.⁴ More specifically, with dental hygiene in Canada, Asadoorian states that quality assurance activities should promote the profession as well as ensure competence.⁴

*In the health professions,
continuing competency is a
component of a quality
assurance program.*

A second aspect of a quality assurance program is protection of the public. Several participants addressed this issue in the focus group discussion. They mentioned that it is important to evaluate one's treatment to ensure it is appropriate and successful. It was also explained that being able to help people effectively is the main reason to maintain one's competent practice. Participants noted the effect of oral health on overall health and how dental hygienists can ensure that this effect is a positive one for their clients. So although the issue of protecting the public was not specifically noted, the participants did refer to it in a more indirect way as an element of competent practice.

Woolf proposed that competence in health professions be kept separate from disciplinary measures.³⁵ Yet the dental hygienists in this study seemed to agree with Exstrom's position, that one duty of a regulatory body in nursing is to assure competence.³¹ The participants suggest that the dental hygiene regulatory body has a role in measuring competency. They also note that the mandatory continuing education policy is partly responsible for motivating dental hygienists in Saskatchewan to attend educational activities. Participants agree that this is a start to keeping current in their practices.

The focus group participants identified self-assessment as the most common tool used to measure maintenance of personal competence. In fact, the group continuously mentioned the importance of self-assessment to competent dental hygiene practice. The use of self-assessment skills was evident when they discussed measuring compe-

tence, growth in personal practice, and continuing learning experiences.

Exstrom suggested that individual nurses were accountable for assessing their own practice and learning needs and for then implementing activities for improvement and development.³¹ The dental hygienists in this study appeared to agree with this perspective. This opinion supports Waddell's assertion that self-assessment contributes to individual professional accountability.²¹ Another participant described reading recent journal articles and discussing dental hygiene practice with colleagues as some of the tools used for self-assessment.

The dental hygienists in this study did not mention using dental hygiene's clinical practice standards to assist in their self-assessment activities.³⁶ Asadoorian identified this previously, reporting that the standards are underutilized by dental hygienists in Canada.⁴ Perhaps if continuing competence were assessed more formally in Saskatchewan, the participants would find the standards helpful in measuring such competence and diagnosing learning needs. Furthermore, Knox discovered that over 50% of continuing education in the professions is self-directed. Professionals therefore need to be able to self-assess in order to choose the direction of their continuing education activities.³⁷ *Dental Hygiene: Definition, Scope, and Practice Standards* could provide a framework for engaging in activities that would contribute to maintaining proficient practice. As previously noted by Forgy et al., using the standards as a self-assessment tool also contributes to each individual's motivation to seek out useful activities.²⁵

The SDHA uses a mandatory continuing education policy to "assist hygienists to remain current in their roles as clinicians, educators, and client advocates"¹ (p. 1). This policy was cited as a reason why some dental hygienists attend continuing education activities. The participants in the study added that the knowledge and skills learned through the activities have to be applied for the activity to be deemed successful in keeping practice current. The participants did not seem to feel that the requirement produced resistance, as had been noted by Woolf in his discussion of global continuing health professional education.³⁵

Regarding the usefulness of continuing education activities, the participants seemed to believe that application of new knowledge and skills was the determining factor in preferring one activity to another. Neither the travel nor costs associated with educational activities were mentioned as considerations when choosing an activity to attend. This was somewhat surprising as the majority of the dental hygienists in the focus group live outside of Regina and Saskatoon, where most of the continuing education activities are held. The opinions of the participants in this study also differed from those of dentists in Alberta in that the dental hygienists seemed to believe in a relationship between continuing education and changing practice, while in Alberta, the findings indicated that dentists found this link unclear.¹⁰


CONCLUSIONS

Two major themes emerged from the data. First, the skill of self-assessment is critical to competent dental hygiene practice; the dental hygienists in the study used self-assessment as a basis for all the focus group discussion topics. Second, communication and client management skills are essential for quality dental hygiene care. The participants in the study rarely referred to technical and clinical proficiency, but rather determined that personal skills were important to develop and maintain. There were no differences in opinion between dental hygienists who practise in urban vs. rural areas.

This study has implications for dental hygiene educators, the SDHA Continuing Education Committee, and for facilitators of continuing education activities. First, self-assessment skills for dental hygienists should be developed during their pre-professional education. Second, continuing education activities should include strategies to enhance interpersonal communication skills, professional values and attitudes. In addition, those activities should also include a plan to integrate the content into practice.

The findings of this study and the review of the literature reveal several areas that require further research and investigation. More research is needed to determine the effects of continuing education on the outcomes of client care. This research should use valid and reliable tools and be specific to dental hygiene practice. Next, as that research will likely include the use self-reported data, the accuracy of self-assessment skills should be investigated.

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ABSTRACTS

The International Association for Dental Research (IADR), in association with the American Association for Dental Research (AADR), and the Canadian Association for Dental Research (CADR) held a combined meeting and exhibition March 9–12, 2005, in Baltimore, Maryland. The IADR General Session consisted of approximately 3,500 scientific presentations: about 1,100 oral/slides presentations and 2,400 poster presentations. Scientists and researchers from around the world present their research findings for discussion. The IADR has given us permission to publish a selection of abstracts presented at that meeting.

MOUTHGUARDS

0414 PRESSURE FORMED VERSUS VACUUM FORMED EVA MOUTHGUARDS: PROTECTION, FIT, DEFORMATION

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Athletic mouth guards have been around for five decades. Improvements have been in custom fabricated types. Until recently, vacuum form machines represented state of the art method; however, pressure form machines are gaining in popularity and may be superior in several ways. **Objectives:** this study compared vacuum form (V) versus pressure form (P) mouth guards for the following features: 1) retained material thickness over the incisal edges, 2) closeness of fit, and 3) distortion with simulated intraoral use. **Methods:** Ethylene Vinyl Acetate (EVA) mgs made with vacuum (Omnivac by S.S.White) and pressure (Biostar by Buffalo Dental) machines were compared by testing incisal edge thickness, fit and distortion. For each variable tested, 4 mouth guards (mgs) were made from each machine. The mgs constructed by vacuum used one 4mm layer of stock EVA, and the pressure mgs were made with two layers of 2mm stock EVA. **Results:** Average thickness over incisal edge for V and P was 0.925 and 1.95 millimeters, respectively. Thus, P had 68% more thickness over incisal edge compared to V (tstat=26.84). In testing closeness of fit, light body impression material was applied to fill residual internal space while applying constant outer pressure. The average weight in grams of impression material for V was 163.06 and P was 140.21, resulting in an average of 22.84 less grams for P (tstat=4.96). Therefore, V mgs contained 14% more internal volume of material than P mgs. Total distortion changes based on the original master cast were measured from incisal cusp tips of the canines. The average distortion for V was 0.01mm in an outward direction, and there was no distortion for P. **Conclusion:** Pressure formed mgs are superior in respect to thickness over incisal edge and in fit; no appreciable difference was seen in distortion from simulated wear.

1963 EVALUATION OF MOUTHGUARD USE AND CONCUSSIONS IN THE NHL

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Objectives: Concussive injuries related to professional sports are becoming an increasing area of study due to the amount of athletes prematurely retiring due to this condition. Prevention is the key in reducing concussive injuries yet the role of mouthguards in this process has been controversial. The objective of this study was to determine if there is a relationship between concussions and mouthguard use in the National Hockey League. **Methods:** Thirty National Hockey League (NHL) teams were reviewed during the 2002-2003 playing season. Data collected included number of players per team who reported wearing a mouthguard, number of players per team who suffered a concussive injury during the season and number of games missed per team due to concussive injuries. Data were analyzed utilizing pairwise correlations. **Results:** Seventy-two players comprised of 52 forwards, 15 defensemen and 5 goaltenders (mean age 29.3) reported concussive injuries during the 2002-2003 NHL season, resulting in 350 missed games. Fifteen players were classified as "out indefinitely" and two players reported season-ending injuries. The average number of years played in the NHL per player was 7.76. Correlation data revealed no significance in the number of players per team wearing

mouthguards and the number of concussions reported per team (p=0.4293). The number of concussions per team was significant compared to the number of games missed per team (p<0.0001). Forwards were significantly more prone to concussive injuries compared to defensemen and goaltenders (p=0.000, 0.014 and 0.664, respectively). **Conclusion:** These results indicate that the number of players wearing mouthguards per team does not significantly relate to the number of concussions reported. Additional factors such as player position, type and location of impact and size and speed of the player need to be addressed for future studies.

0420 ENERGY ABSORPTION OF THREE MOUTHGUARD MATERIALS AT HIGHER IMPACT SPEED

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High impact energy absorption is essential for mouthguard materials. Last year (IADR Abstract No. 565) we reported energy absorption of three mouthguard materials at impact speeds of 5 mph and 10 mph. **Purpose:** Compare these materials at the much higher impact speed of 20 mph. **Methods:** 3 inch x 3 inch x 4 mm test specimens were prepared from (a) ethylene vinyl acetate (EVA, T&S Dental and Plastics, Myerstown, PA), serving as the control, (b) ProForm (Dental Resources Inc, Delano, MN), another ethylene vinyl acetate material, and (c) Polyshok (Sportsguard Laboratories, Kent, OH), a ethylene vinyl acetate product containing polyurethane. Specimens were loaded at 20 mph by a 0.5-inch diameter indenter that contained a force transducer (Dynatup Model 9250 HV, Instron Corp, Canton, MA). Energy absorption during the impact process was determined from the area under the force-time curve, using computer software with the testing apparatus. Results were compared using ANOVA and the Tukey-Kramer HSD test. **Results:** Total energy absorption (mean ± standard deviation for N = 5), normalized to specimen thickness, for the 20 mph impact speed was (ft•lb/inch): EVA, 103.9 ± 48.2, ProForm: 55.3 ± 6.0, and Polyshok, 192.0 ± 10.2. The energy absorption at 20 mph was significantly different for all three materials, and was much lower for EVA and ProForm than for the 10 mph impact speed. There was minimal difference in energy absorption for Polyshok at these two impact speeds. All EVA and ProForm test specimens punctured at the 20 mph impact speed, but none of the Polyshok specimens punctured. **Conclusions:** For the higher loading speed of 20 mph with this impact test, the energy absorption of Polyshok is superior to that for EVA, which is superior to that for ProForm. The ability of Polyshok to completely withstand puncturing is an advantageous feature.

CARIOLOGY

3154 PATIENTS' ATTITUDES TO MANAGING CARIES WITH OZONE

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Ozone is currently being used by thousands of Dentists as an alternative to local anaesthesia, conventional drilling and filling for the management of dental caries. Treatment with ozone [HealOzone, KaVo] is only required for seconds and has been shown to clinically reverse

root caries in clinical trials (Gerodontology. 2003 Dec;20(2):106-114 and Am J Dent. 2004 Feb;17(1):56-60). **Objectives:** To determine the attitudes and dental anxiety of patients in a general dental practice in Germany to ozone treatment. **Methods:** Attitudes and dental anxiety were assessed on a 5-point Likert scale. Patients (n=98) who had a carious lesion treated with conventional drilling and filling within the previous 12 months and who had a similar carious lesion requiring treatment by the same dentist took part. 100% of patients participated and 100% completed the questionnaire. **Results:** The results showed that all patients were happy or satisfied with the ozone treatment they received and were happy or satisfied with the amount of time the ozone treatment required. 66% were satisfied to choose this treatment even if the ozone treatment cost more than regular conventional treatment, 100% would recommend this treatment to a friend or close relative and 100% would like to receive this treatment again. 100% of subjects were not anxious after the ozone treatment and reported less anxiety after, compared with before, the ozone treatment. 86% of patients reported a reduction in anxiety ($p < 0.05$). **Conclusions:** The results of this survey suggest that patients attending a general dental practice were happy or satisfied with ozone treatment to manage their dental caries and would be happy to even pay more for this treatment than conventional drilling and filling. The ozone treatment was associated with a reduction in anxiety.

3245 BACTERIOCIDAL EFFECTS OF CARBAMIDE PEROXIDE BLEACHING GEL

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Objective: This in vitro study was to evaluate and compare the effect of carbamide peroxide on the bacteria in fissure lesions (non-cavitated). **Methods:** Thirty molar teeth had root apices obturated and surfaces painted with an acid-resistant varnish so that a 1 mm wide area of enamel was exposed, with the fissure(s) centered in the exposed strip. An acidic gel, pH 4.5, was prepared, and teeth were immersed for a period of five weeks to create demineralization within fissures; fresh gel was made weekly. Mineral loss range was 1129-2205 vol%.µm; lesion depth 52-98 µm. Teeth were then autoclaved. Twenty teeth were randomly selected, incubated in MRS broth containing lactobacillus for 48 hours to infect the demineralized enamel within fissures. Ten of those 20 teeth were then sectioned and biopsy of subsurface tooth structure within each lesion was performed (positive control). The other ten were placed in a solution of 10% carbamide peroxide (Opalescence) gel for two hours and then sectioned and biopsied in the same way (experimental group). The lesions in the remaining ten sterile (negative control) teeth were also biopsied. Lesions involved only enamel within the fissure. The biopsied demineralized tooth structure from the three groups was placed in individual vials containing sterile MRS broth and incubated for 48 hours, diluted, and then plated on B-12 culture medium. **Results:** Both the negative control and the experimental groups showed no growth when plated. The positive control group showed a strong lactobacillus growth (924×10^5 CFU/ml) with no contamination. Due to the result that either all or none were infected, no statistical analysis was needed. **Conclusions:** The 10% carbamide peroxide gel was bacteriocidal within fissure caries lesions and penetrated the fissure and carious tooth structure to kill bacteria. Study was funded in part by Ultradent Products.

TOBACCO

3306 ADDICTION AND BELIEFS RELATED TO TOBACCO AMONG ADOLESCENT TOBACCO USERS

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Objective: The objective of this study was to assess symptoms of nicotine addiction, and beliefs related to tobacco use, quit attempts and relapse among male and female high school students in rural northern California. **Methods:** After gaining IRB approval and positive parental consent, we conducted a self-administered questionnaire among 123 high school-aged adolescents at three sites. The survey assessed symptoms of nicotine addiction related to first use and current use of tobacco, reasons for use, factors that would motivate quit attempts, reasons

for relapse, and other psychosocial variables related to tobacco use. **Results:** Over 50% of respondents identified: tension reduction and cravings as reasons for use; oral health-related factors as quit attempt motivators (e.g., gum disease, mouth cancer, changes in voice, stained teeth, and bad breath; and desire for tobacco, boredom, personal problems, withdrawal symptoms, and social pressure as reasons for relapse. **Conclusion:** Future research is needed to determine the efficacy of adolescent tobacco cessation programs that highlight the oral health benefits of quitting, address peer pressure to continue to use tobacco, and provide behavioral and pharmacological strategies for coping with nicotine cravings and withdrawal symptoms during the quitting process. Study supported by NIH/COHRCD DE13058 Project 11.

1084 LONG-TERM INFLUENCE OF SMOKING TO THE PERIODONTAL TISSUE

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Objectives: The purpose of this investigation was to examine the long-term influence of smoking on periodontal health. **Methods:** The data derived from a 20-year longitudinal study of a group of Norwegian middle class males characterized by good to moderate oral hygiene and regular dental check-ups. At each of 6 surveys between 1969 and 1988, the mesial and buccal surfaces and from 1975 onwards also the distal and lingual sites were scored for dental and periodontal parameters. The subjects were subset according to their smoking history into non-smokers and smokers. **Results:** Before 20 years of age the non-smokers exhibited higher Gingival Index scores, but after the age of 30-years the smokers had more sites that bled on probing. The smokers exhibited more subgingival calculus formation in the maxilla and incisors of the mandible after the age of 30 years. Smokers exhibited higher mean Calculus Index scores in the maxilla and at the incisors in the mandible in the 3rd and 4th decade of life. This corresponds to the fluctuation levels of the mean Gingival Index scores. The gingival recession level was quite stable for the smokers, while the non-smokers showed increasing recession values with age, but at the end of the 4th decade there was no difference. There were significantly more sites with deeper pocket depths in the smoking subjects than in the non-smokers. At baseline, the 2 groups showed the same amount of attachment loss (0.14mm), but with increasing age and observation time, the periodontal loss increased significantly faster in the smoker cohort, yielding values of 1.59mm and 2.22 mm respectively. **Conclusions:** Smoking was highly associated with increased calculus formation, especially in maxillary teeth and the incisors of the mandible, and was confirmed as an important risk factor of periodontal disease progression.

PERIODONTOLOGY

1066 ASSESSING THE RELATIONSHIP BETWEEN THE PERIODONTAL INDEX AND PROBING DEPTH

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Objective: The purpose of this pilot study is to examine the relationship between the Periodontal Index (Russell) and full mouth 6 sites per tooth measurements using the criteria used by NIDCR to assess periodontal destruction. **Methods:** A convenience sample of 22 adults (16 Male/6 Female), age 30 to 72 (mean 41.9, ± 2.7), with ≥ 20 teeth and no prophylaxis during previous 12 months was used. The NIDCR (Miller et al. 1987) diagnostic criteria and instruments were used to conduct full mouth examinations of gingival bleeding, dental calculus, pocket depth (probe depth) and attachment loss. Descriptive statistics, correlational analyses and tests of agreement between the two methods of measuring periodontal disease were conducted. **Results:** Clinically the group mean Periodontal Index (PI) score (2.07, SE 0.14) equated to "beginning destructive periodontal disease" which was similar to the clinical diagnosis of localized mild to moderate chronic periodontitis based on six sites per tooth. Pearson correlation coefficients between the PI and Calculus ($r=0.7693$, $p<0.001$) and Marginal Bleeding ($r=0.5163$, $p=0.0129$) were meaningful and statistically significant. Correlations between the PI and probe depth ($r=0.2508$, ns) and attachment loss (AL) ($r=0.1753$, ns) were weak. The percentage of agreement between the PI scores and pocket depth and attachment loss ≥ 4 mm were poor with Kappa coefficients ranging from -0.0669 to

0.0199 respectively. For pocket depth (< and ≥4mm), observed agreement was 30.0% (p=0.9930); and for attachment loss, 38.7% (p=0.1942). The PI underestimated the frequency of periodontal pockets ≥4 mm by 63.2% (CI 59.3 to 67.1%) and overestimated the frequency < 4 mm by 6.8% (CI 4.8 to 8.8%). A similar pattern existed for attachment loss. **Conclusions:** In this sample of adults with clinically mild to moderate chronic periodontitis, the PI significantly underestimated the presence of periodontal pockets ≥4 mm.

GERIATRIC ORAL RESEARCH

0723 EFFECT OF VITAMIN E AND FLUORIDE ON PLAQUE AND GINGIVAE

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Objectives: The aims of this clinical study were to compare the effect of dentifrices containing Vitamin E and/or fluoride on plaque and gingival thickness by the employment of three-dimensional superposition technique and clinical indices and to assess the retention of Vitamin E and fluoride in plaque. **Methods:** This study was carried out using a double-blind cross-over design. Ethical approval and a Clinical Trial Exemption Certificate were obtained prior to the study. A total of 30 subjects [10 (33%) male and 20 (67%) female] were recruited and they were randomly allocated to three cross-over treatment groups. Treatment A. Subjects received dentifrice containing 2,500 ppm fluoride and Vitamin E. Treatment B. Subjects received dentifrice containing 2,500 ppm fluoride only. Treatment C. Subjects received negative placebo dentifrice neither containing fluoride nor Vitamin E. Clinical assessments (Modified Turesky Plaque Index, Lobene modification of the Loe and Silness Gingival Index, Modified Papillary Bleeding Index) and three-dimensional superposition technique were performed. Contents of fluoride and Vitamin E in plaque were also obtained. **Results:** Metrological and clinical analyses revealed that there were significant reductions regarding gingival thickness, papillary bleeding and plaque indices in the group using dentifrice containing fluoride and Vitamin E when compared to the other groups (p < 0.05). However, there were no statistical differences in plaque thickness and gingival index (p > 0.05) between three groups. The quality of use was also evaluated. Two (8%) subjects on dentifrice containing Vitamin E and fluoride, 3 (13%) subjects dentifrice containing fluoride only and 1 (4%) subject on placebo dentifrice rated dentifrices unfavourably. **Conclusion:** The adjunction of Vitamin E 0.5% to a dentifrice containing 2,500 ppm fluoride thus led to an improvement in gingival swelling. This formulation may exert a preventive action against the development of gingivitis, although there was no additional benefit on the plaque thickness.

EDUCATION RESEARCH

2016 A COMMUNITY-BASED ORAL HEALTH INTERACTION WITH CHILDREN

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Objective: The aim of this study was to assess the baseline oral health knowledge and evaluate it again after an educational intervention for high-risk children enrolled in the Boys and Girls Clubs of Metro Richmond (BGCMR). **Methods:** A prospective cohort study design was used to assess the effects of the educational intervention on oral health knowledge. The oral health education provided used the revised Crest Cavity Free Zone Curriculum. In the after-school programs, children were examined with a baseline questionnaire at the beginning and then received the identical questionnaire at the end of the educational intervention. The curriculum was taught for an eight-week session by Virginia Commonwealth University dental and dental hygiene students. The educational curriculum includes the basics of oral disease, oral hygiene, and proper nutrition. The Crest Cavity-Free Zone Program is divided into three modules based on age, specifically ages 6-9 (module 1), ages 10-12 (module 2), and 13-15 (module 3). Each module is designed to accommodate the needs of each specific age group and developmental levels. **Results:** The principal outcomes were the change in class room-level oral health knowledge, computed by subtracting baseline scores from follow-up scores. Fifty-one children completed the pre-test with 53% (n=27) children completing the post-test. The average pre-test score of 4.3 improved to a post-test

score of 7.2 (max score=10). The most significant improvement was in module 2 (age 10-12). Overall, majority of the children showed improvement at the conclusion of the curriculum. **Conclusions:** Educating high-risk children showed improvements in their understanding of oral health and its general importance. This study can be further improved by evaluating the effects of education on their oral health in long term (2-3 years later).

NUTRITION

802 MEAL AND SNACK CARBOHYDRATES AND CARIES AT AGE 5

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Frequent snacking on fermentable carbohydrates is considered a risk factor for caries. However, evidence supporting associations between caries and carbohydrate exposures at meals or snacks is limited. **Objective:** To compare meal and snack exposures to individual types of carbohydrates in children with and without caries participating in the Iowa Fluoride Study. **Methods:** Exposures to sugars and starches at meals and snacks were abstracted from 3-day diet diaries completed at 1, 2, 3, 4, and 5 years of age and calculated for 1-to 5-years combined. Fluoride intakes were calculated from estimates of water, beverages, select foods, dentifrice and supplements reported by questionnaire from age 6 weeks to 5 years. Caries experience was defined as any dfs at age 4.5-6.9 year exams. Logistic regression models developed to predict caries experience for the upper vs. lower quartile of exposure frequency were adjusted for age at dental exam and estimated fluoride intake. **Results:** Increased caries risk was associated with higher snack exposures to: sugar-based desserts for age 2, 4 and 1- to 5-years, sugar condiments at age 4 and 1- to 5-years, "all sugars" at age 4 and 1- to 5-years and unprocessed starches for ages 3, 4 and 1- to 5-years (p < 0.05). Decreased caries risk was associated with higher meal exposures to: sugar-based desserts at ages 1- to 5-years, "all sugars" at 3 and 1- to 5-years, unprocessed starches at 1- to 5-years and "all starches" at 4, 5 and 1- to 5-years (p < 0.05). **Conclusion:** These results suggest that timing (i.e., meal vs. snack) influences the relationship between carbohydrate exposures and caries risk. Supported by the ATPM/CDC (TS-0652), the NIDCR (RO1-DE09551 and RO1-DE12101) and GCRCP (M01RR00059).

0812 VITAMIN SUPPLEMENTATION AND ITS RELATIONSHIP TO PERIODONTAL DISEASE

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Objective: The purpose of this study was to determine if people who supplemented daily with vitamins that have been associated with periodontal health had less periodontal disease than people who did not supplement with these vitamins. In a previous study we have shown that a daily multivitamin slowed the progression of periodontal disease. **Methods:** 134 volunteers aged 60-95 (mean age 69 both groups) from the greater Boston area completed 3-day food diaries that included vitamin intake. Periodontal assessments were done, measuring pocket depth and attachment loss. **Results:** A comparison was made between those individuals that had periodontal disease (had teeth with pockets greater than 4mm n=42 45% male/55% female) and those that did not have periodontal disease n=91 35% malw/45%female). The two groups had the same average number of teeth (19). Eighty percent of both groups had received regular medical and dental care. Cigarette smoking was minimal in both group (NS difference). The group that did not have periodontal disease supplemented significantly more with certain nutrients. Supplementary intake of B5 was higher for the non-periodontal group (5.79 mg vs. 3.33 mg, MW p<.038), as was intake of B6 (8.39 mg vs. 2.4 mg, MW p<.050) and B1 (4.00 mg vs. 0.91 mg, p<.01). Supplementary intake of Vitamin E was also greater for the non-periodontal group than the periodontal group (101.44 mg vs. 51.31 mg, MW p<.050), as was intake of Vitamin D (130.77 IU vs. 96.83 IU, p<.005). **Conclusion:** Supplementation with antioxidants such as Vitamin E and with B vitamins that improve wound healing may be associated with better periodontal health. Vitamin D improves bone health. Interventional studies with RCT would be necessary to prove this. This study was funded by the USDA.


je ne mettrais pas quelqu'un qui a peur des hauteurs au défi de se lancer en parachute du haut d'un avion. Je pense cependant que nous sommes tous et toutes en mesure d'envisager d'étendre notre zone de confort peu à peu chaque année. Relever de nouveaux défis et essayer des choses que l'on avait eu peur d'essayer auparavant, cela ne peut que servir à élargir nos horizons et mener à une vie plus remplie.

Nous hésitons parfois à accomplir de nouvelles tâches par crainte de l'échec, de la critique ou du ridicule. Franchement, il y a de bonnes chances que nous essayions des revers dans toute nouvelle activité. Nous ne savons pas tout, et c'est très bien ainsi! Eleanor Roosevelt a dit un jour : « Le seul homme qui ne commet pas d'erreur est celui qui ne fait jamais rien. » Richard Bach va plus loin en disant : « Les erreurs n'existent pas. Les événements qui nous arrivent, aussi déplaisants soient-ils, sont nécessaires pour que nous apprenions ce qu'il nous faut apprendre; quoi que nous fassions, ils sont nécessaires pour nous permettre de parvenir là où nous avons choisi d'aller. » En effet, le processus d'apprentissage par lequel nous passons dans nos efforts pour parvenir à nos objectifs est ce qui forge le caractère et nous pousse, avec confiance, à relever de nouveaux défis. La crainte de l'échec n'est pas une bonne raison pour rester sur la touche à regarder la vie passer ou à attendre que d'autres ouvrent la voie.

Heureusement, la profession d'hygiéniste dentaire a eu dans ses rangs un certain nombre de pionnières suffisamment courageuses pour emprunter une avenue inexplorée afin d'améliorer l'avenir de la profession. Sans ces hygiénistes dentaires, la profession ne serait pas rendue là où elle est aujourd'hui. Le moment n'est pas venu de nous reposer, cependant, car il y aura toujours des tentatives de réduire l'envergure de notre profession. En conséquence, nous devons continuer de faire preuve de vigilance et nous efforcer de protéger et d'élargir l'envergure actuelle de notre profession afin de mieux servir notre clientèle. En outre, nous devons nous tenir au courant de l'évolution de la technologie et des nouvelles façons de procéder qui remplacent les pratiques de traitement sorties de l'usage.

Offrez vos services et vos compétences pour contribuer à l'avancement de notre profession ou pour apprendre quelque chose de nouveau. Nous sommes des professionnelles et des professionnels instruits, qui se dévouent au service du public. Les mots ont de l'importance, mais les gestes de notre part doivent suivre.

Comme la saison des Fêtes s'en vient, je vous souhaite à toutes et à tous paix, joie et bonheur ainsi que des activités stimulantes pour l'année à venir.

On peut communiquer avec Diane Thériault à l'adresse <president@cdha.ca>. 

Nouveaux débuts (suite de la page 255)

marché du travail après avoir suivi leurs cours de diplôme sur une période réduite.

- On commence à voir apparaître des ententes d'articulation entre collèges et universités. Celles-ci permettront aux titulaires d'un diplôme de s'inscrire au baccalauréat.
- L'American Dental Hygienists' Association a établi un plan quinquennal en vue de faire du diplôme de baccalauréat la condition d'exercice de la profession; elle a aussi conçu un plan de dix ans pour les programmes de maîtrise et de doctorat en hygiène dentaire. L'Association plaide aussi en faveur de la mise sur pied de deux niveaux de professionnels en hygiène dentaire, grâce à la création du titre de praticien avancé en hygiène dentaire (*advanced dental hygiene practitioner* ou *AHDP*).
- Il se peut que les sous-ministres de la Santé fédéral, provinciaux et territoriaux (http://www.scics.gc.ca/confer05_f.html) travaillent sur la mobilité des professionnels de la santé d'un bout à l'autre du Canada. Ainsi en viendra-t-on peut-être à uniformiser l'étendue du champ de pratique d'une province ou d'un territoire à l'autre.
- L'étude pluriannuelle sur le secteur de la santé bucco-dentaire financée par Ressources humaines et Développement des compétences Canada a tourné en queue de poisson par suite d'un manque de coopération

de la part des organismes qui détiennent des données sur la santé bucco-dentaire.

- Le projet de norme nationale en matière de réclamations électroniques a pris fin graduellement pour passer au stade de la stratégie de mise en œuvre. On s'attend à ce que la santé bucco-dentaire soit l'un des derniers domaines de service visés par la mise en œuvre, en raison de l'existence du système CDAnet.
- L'hygiène dentaire dispose désormais d'une fondation : la Fondation canadienne pour la recherche et l'éducation en hygiène dentaire. Celle-ci vise à appuyer la recherche et l'enseignement dans le domaine et à les faire progresser.
- Le Symposium international sur l'hygiène dentaire aura lieu à Toronto en juillet 2007. Voilà une occasion de mettre en valeur le travail des hygiénistes dentaires du Canada et de collaborer avec des hygiénistes dentaires du monde entier dans des dossiers qui revêtent de l'importance pour la profession.
- Les élections fédérales, qui sont imminentes, constituent l'occasion de demander aux femmes et aux hommes politiques de prendre un engagement envers la santé publique qui aille au-delà de la préparation aux situations d'urgence et des questions du genre SRAS et s'attache plutôt au financement adéquat de la prévention ainsi qu'au travail de promotion de la santé.


Outre ces points, le futurologue bien connu Karl Albrecht fait remarquer que, pour votre association professionnelle* :

- le service communautaire n'est plus une solide valeur sociale;
- les cohortes de gens qui ont de 20 à 40 ans ne manifestent pas le même besoin d'attaches que leurs aînés;
- la loyauté entre travailleurs et employeurs diminue;
- les gens déménagent souvent; aussi est-il moins probable qu'ils développent des racines communautaires;
- Internet et les communautés d'intérêts virtuelles remplacent les collectivités géographiques comme source de camaraderie.

* K. Albrecht, « Is the association model broken? The case for reinvention », *Journal of Association Leadership*, vol. 3, no 2 (2005), p. 6-19.

Que nous disent donc tous ces points? D'abord, que l'hygiène dentaire s'apprête à connaître des changements. Comme l'indique Roger Smith dans la citation ci-dessus, nous devons être des participants actifs dans la création de notre avenir et ne pas laisser uniquement les choses nous arriver. Deuxièmement, ils disent à l'ACHD, votre association professionnelle, qu'il lui faut continuer d'améliorer sa valeur à vos yeux. Pour être précis, nous allons nous employer à susciter la camaraderie, à faciliter l'assistance mutuelle, à plaider en votre nom, à continuer d'élargir la gamme de produits et de services sans pareils que nous vous offrons et d'améliorer les occasions d'apprendre et de progresser. Dans le présent numéro, l'étude qualitative de Brenda K. Udahl au sujet de la formation continue et de la compétence professionnelle et le plus récent exposé de position de l'ACHD à propos des protège-dents vous donneront l'occasion d'apprendre et de progresser.

Merci de continuer d'investir dans votre profession.

Et bonne année. Susan 

New Beginnings (continued from page 255)

They are also advocating for two levels of dental hygiene professionals with the creation of an advanced dental hygiene practitioner (ADHP).

- Federal/Provincial/Territorial Deputy Ministers of Health (www.scics.gc.ca/confer05_e.html) may be working on the mobility of health care providers across Canada. This may allow the scope of practice to be made consistent from one province or territory to the next.
- The multi-year Oral Health Sector Study funded by Human Resources Development Canada faded away into non-existence due to a lack of cooperation by those who hold oral health data.
- The National E-claims project wound down and has moved to an implementation strategy stage. Oral health is expected to be one of the last service areas to be implemented due to the existing CDAnet system.
- Dental hygiene now has a foundation, the Canadian Foundation for Dental Hygiene Research and Education, to support and advance dental hygiene research and education.
- The International Symposium of Dental Hygiene is being hosted in Toronto in July 2007. This represents an opportunity to showcase the work of Canadian dental hygienists and to work together with dental hygienists from around the world on issues of importance to the profession.
- The impending federal election provides the occasion to ask politicians for a commitment to public health that goes beyond emergency preparedness and SARS-type issues and moves to adequate funding for prevention and health promotion work.

In addition to these points, well-known futurist Karl Albrecht notes that for your professional association*

- community service is no longer a strong societal value;
- the age 20-to-40 cohorts do not demonstrate the same need for affiliation as do their elders;
- loyalty between workers and employers has faded;
- people move more frequently and are less likely to develop community roots;
- the Internet and virtual communities of interest are replacing geographical communities as a source of fellowship.

So what do all of these points tell us? Well, first that there are changes afoot for dental hygiene. As Roger Smith notes in the quotation above, we must be active participants in creating our future, not just letting it happen to us. Second, they tell CDHA, your professional association, that we must continue to improve our value to you. Specifically, we shall work toward building fellowship, shall facilitate mutual assistance, advocate on your behalf, continue to expand our offerings of unique products and services, and enhance opportunities for learning and growth. In this issue of the journal, your opportunities for learning and growth are enhanced with Brenda K. Udahl's qualitative research study on continuing education and professional competence and the latest CDHA position paper on mouthguards.

Thank you for continuing your investment in your profession.

Happy New Year. Susan 

* Albrecht K. Is the association model broken? The case for reinvention. *J Assoc Leadership*. 2005;3(2):6-19.

Finding the Right Words

by CDHA Staff

CONTINUING OUR SHORT SERIES ON “FINDING WHAT You Want,” this month we are looking at finding the best words or phrases to use in your Internet search.

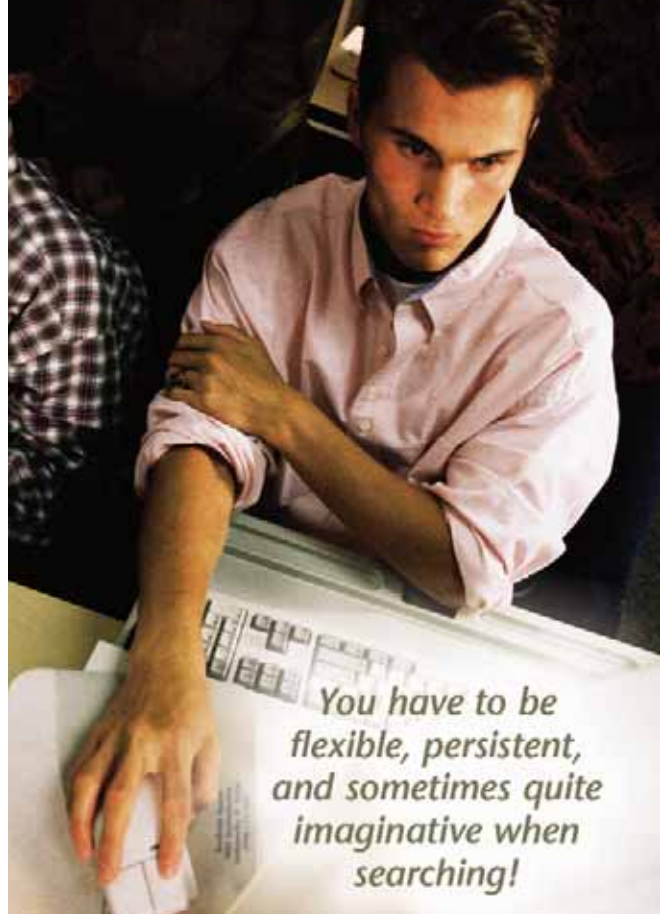
The first step when doing research is to formulate the question (see the “Do No Harm” article in the September-October 2004 issue of *CJDH*). The next task is to find all of the terms that will cover the topic and capture most of the relevant literature. This may not seem like a major job but finding the most appropriate terminology for your search is the most time consuming and vital part of doing research. Search results can vary tremendously because of your choice of search terms and because of the “indexing language” of the different databases. Databases are not at all consistent in how they index articles so you have to be flexible, persistent, and sometimes quite imaginative when searching!

To do a thorough scan of a topic, both generic and indexing terms are needed. We'll use an article in this issue to show what we mean. To search for articles on “mouthguards for athletic use,” we used both plural and singular spelling variations of the common term *mouthguards*, *mouth-guards*, *mouth guards*. We also used the National Library of Medicine (NLM) terms *mouth protectors* and *protective devices*. These terms are from MeSH—Medical Subject Headings—used by the NLM. The MeSH site is invaluable as it shows current terms as well as previously used terminology for most medical and dental subjects as well as the relationships among terms. To locate medical terms that you can use for searches, particularly in PubMed/Medline, see www.nlm.nih.gov/mesh/mesh-home.html.

If you use the CINAHL subscription database (Cumulative Index of Nursing and Allied Health Literature) at www.cinahl.com to search the same topic, you have to use their on-line term *mouthguards* in a subject search or any of the generic forms if you were searching the title field for example. The term *mouth protectors* is not applicable to this database.

When we did the search, we combined the original terms with others covering the concepts such as *orofacial injuries*, *mouth*, etc. From the test search, we found that the broad term *protective devices* led us to articles that discussed using mouthguards for the prevention of injuries due to other physiological/psychological ailments. When we added terms such as *athletic injuries* and sports-related generic terms to our search terminology, we obtained more meaningful results.

It is extremely important to keep track of your search terms and the results that they pull up. That way, you can identify what terms, and combinations of terms, produce the most useful results. For example, if you use the term




EyeWire Collection/Getty Images

oral health (NLM defines this as the “state of the health of the mouth”) on the Health Canada website, you may be surprised to get results on Reproductive and Sexual Health. If you use the term *dental health*, which was commonly used in the literature until fairly recently, on the same Health Canada database, you will get a surprisingly different result. This happens because terms change their meaning over time but the indexing of database contents may not be updated as terminology changes. As well, the mechanisms that drive the search engine for the database may search for individual words wherever they may occur in the database rather than the phrase you intended. For instance, typing “oral health” will bring up information that contains the two words oral AND health wherever they may occur in a document. This may not necessarily be the information you would expect to find when searching on this term. This all can lead to a great deal of frustration. Some websites have “advanced search” capabilities that help alleviate this outcome and we'll look at this in detail next month.

Once you have the appropriate terminology established, the next step is to use it on the numerous free and subscription databases on the Internet. In the next issue in January 2006, we will discuss how to develop a search strategy using Boolean (AND, OR, NOT) logic or the use of quotation marks, * or phrase searching. We will also provide some simple hints on how use PubMed/Medline and other databases successfully.

Other sources for terms and definitions are Canadian Subject Headings at www.collectionscanada.ca/csh-bin/search/I=0 and the U.S. Library of Congress On-line at <http://catalog.loc.gov/>.

We'll continue the discussion next time. 

For Children and Parents Alike...

by CDHA Staff

HOW TO CARE FOR CHILDREN'S TEETH IS QUITE PROPERLY a concern of parents. They want to know the best way to prevent cavities and ensure healthy gums in babies, toddlers, children, and teenagers. Clear, straightforward discussions of possible problem areas and what can be done about them are a great help. The sites below all provide good information written in plain language; some deal only with one age group while others look at the whole range of ages. We have also given some web addresses for sites that deal with mouthguards, sites in addition to those mentioned in the position paper in this issue.

Dental Hygiene: How to Care for Your Child's Teeth

<http://familydoctor.org/227.xml>

Aimed at parents, this website looks at topics such as using fluoride tablets, assessing whether their child is at risk for caries, and thumb-sucking.

www.kidshealth.org/PageManager.jsp?dn=familydoctor&lic=44&ps=303&cat_id=43

Under the section *Kids' Health Problems, Teeth and Mouth*, are straightforward articles written for young people about such things as bad breath, braces, adenoids, canker and cold sores, going to the orthodontist, snoring, bruxism, retainers, and tonsillitis.

Ms Flossy's Dental Hygiene News, Children's Dental Health

www.ms-flossy.com/

This site, managed by an individual, has much to commend. Under the tab *Children's Dental Health* is a section called *Smiley's Corner* with links to topics such as My Teeth, My First Visit, About Braces, Baby Bottle Decay, Seal Out Decay, Fun & Games. Another section is *Healthy Teeth*, an oral health education database aimed at elementary school children. Here the children have simple and colourful explanations about cavities, braces, teeth and gums, and very graphic illustrations of what smoking does to your teeth. Another link is an external one to *The Smilestones*, an Australian site that educates children through comics.

In addition to the children's area, there are other major areas such as *For the Public* with topics such as Smoking and Oral Health, Diabetes and Oral Health, It's not "Just a Cleaning."

BDASmile (British Dental Association)

www.bda.org/smile/

This site provides independent information for consumers written in an easy-to-understand format and presented in an attractive site that's easy to navigate. The *BDA 3D Mouth* section is a way to "learn about dental anatomy,



conditions, treatments and good oral health with our cutting-edge 3D educational tool" (Flash and Shockwave players needed). Great graphics explain the "lifetime of teeth," various conditions, treatments, oral hygiene, and diet advice.

Four other sections deal with issues and concerns specific to the various age groups, *Infants & Children*, *Teens*, *Adults*, and *50+*. For example, under *Teens* are such topics as orthodontics (braces, retainers), oral hygiene (bad breath and smoking), treatments (braces, fillings and restorations, extractions, wisdom teeth), and common problems (crooked teeth, accidents, mouth sores). Implants and crowns are found in the *50+* section while the largest section (*Adults*) deals with a broad range of treatments, cosmetic dentistry, common problems, and oral hygiene methods.

Medline Plus, Child Dental Health

www.nlm.nih.gov/medlineplus/childdentalhealth.html

Here we find interesting links to articles and websites *Latest News* (Parents' Smoking May Discolor Kids' Gums), *From the National Institutes of Health* (Healthy Mouth for Your Baby), *Overviews* (Brush Up on Healthy Teeth, How to Care for your Child's Teeth), *Treatment* (Conscious Sedation, Endodontic Treatment in Children), *Prevention/Screening* (Brushing and Flossing Your Child's Teeth, Fluoride, Mouthguards, Sports Safety), *Pictures/Diagrams* (Tooth Eruption Charts), *Nutrition* (Are You Feeding Your Child Tooth-Friendly Foods?), *Related Issues* (Calming the Anxious Child, Enamel Fluorosis).

MOUTHGUARDS

Academy of General Dentistry

www.agd.org/consumer/topics/mouthguards/

This site contains various articles on mouthguards and when one should use them.

Sports Dentistry Online

www.sportsdentistry.com/mouthguards.html

This has a succinct overview of the different types of mouthguards.

Note: The name of the journal changed from *Probe* to the *Canadian Journal of Dental Hygiene*, starting with the September/October 2004 issue. Page references are to the issue and first page of the article.

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Step Out of Your Comfort Zone (continued from page 251)

Sometimes we hesitate to take on new challenges because we fear failure, criticism, or ridicule. Quite frankly, there *is* a good chance we will encounter setbacks in any new endeavour. We don't know everything. And that's ok! Eleanor Roosevelt once said that "the only man who makes no mistakes is the man who never does anything." Richard Bach goes further by saying "there are no mistakes. The events we bring upon ourselves, no matter how unpleasant, are necessary in order to learn what we need to learn; whatever steps we take, they're necessary to reach the places we've chosen to go." Indeed, the learning process we go through as we strive to reach our goals is what builds character and confidence to take on more challenges. The fear of setbacks is not a good reason to sit on the sidelines, watching life pass us by or waiting for others to "break the trail."

It is fortunate that the dental hygiene profession has had a number of trailblazers courageous enough to embark on an uncharted road to better the future of our profession. Without these dental hygienists, the profes-

sion would not be where it is at today. However, this is not the time to rest, as there will always be attempts to reduce the scope of our profession. As a consequence, we must remain vigilant and strive to protect and expand the existing scope of our profession to better serve our clients. Furthermore, we must stay current with changes in technology and new procedures that replace treatment practices as they become obsolete.

Volunteer your services and skills to further to better our profession or learn something new. We are educated professionals, dedicated to serving the public. Words are important but we must follow them up with action.

As the holiday season approaches, I wish you all peace, joy, happiness, and challenging endeavours for the coming year!

You can contact Diane Thériault at <president@cdha.ca>. 

