

Critical Issues in Dental Hygiene

The Role of Dental Hygiene in Caries Management: A New Paradigm

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Historical Role of Dental Hygiene in Caries Management

The concept of prevention as the most ideal approach to caries reduction is not new to dental hygiene. It was this very idea that motivated Dr. Alfred Fones to create the school which graduated the first formally educated dental hygienists in 1914.¹ In addition to providing clinical instrumentation, the larger historical role of dental hygiene has been in helping to prevent dental disease through education. This has been accomplished primarily by an emphasis on removal of biofilm by mechanical means including brushing, flossing, tongue scraping and, in more recent years, chemotherapeutic modalities. Data has shown that these strategies are proven to be beneficial in patients with oral biofilm control problems.⁶ However, the majority of adults do not follow an adequate home-care routine. Average brushing times are low, and only a minority of patients regularly floss.²

The advantages of topical fluoride in a variety of forms has been firmly established.³ In 2001 the Center for Disease Control and Prevention (CDC) advised that it was beneficial for patients of all ages to drink water with optimal fluoride concentration and brush twice daily with a fluoridated toothpaste.⁴ Since then, the CDC has reported that “nearly 70% of U.S. residents who get water from public water systems now have fluo-

Abstract

Purpose: Dental caries is the most common disease of children and remains a significant oral health problem worldwide for both children and adults. The traditional paradigm of treating dental caries solely by “drilling and filling,” brushing and flossing and lowering sugar intake has evolved. Current science in the management of dental caries suggests a clear focus on the reduction of responsible infectious agents, remineralization of non-cavitated lesions and minimally invasive restorative approaches whenever possible. The paradigm shift is away from a purely surgical approach toward more preventive and curative clinical protocols. This paper provides a review of this caries management methodology and explores the role of the dental hygienist in this paradigm change.

Key words: caries balance, CAMBRA, remineralization, non-cavitated lesion, minimally invasive dentistry

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ridated water.”⁵ The percent of caries reduction from topical fluoride varies depending on when the study was conducted and the type and frequency of fluoride used.⁶ A meta-analysis consisting of 8 studies using fluoride varnish conducted by Helfenstein demonstrated an overall reduction of 38% in dental caries.⁷

Regular fluoride application has been delivered in the dental office as a preventive measure or as additional therapy for higher risk patients. However, a survey of 498 dental hygienists in the United States in 2000 revealed that, although a majority of respondents recognized that adults, including a growing number of geriatric patients with patterns of root

caries, could benefit from topical fluoride application, the dental hygienists were not consistently offering this treatment in their practices.⁸ The degree to which the historically low rate of third party reimbursement for preventive services contributed to the findings of this survey was not explored.⁹ Data regarding use of fluoride varnishes were not included in this survey.

Dental sealants, often placed by the dental hygienist, provide a clear benefit to prevention of occlusal carious lesions.¹⁰ A recent report of the American Dental Association Council on Scientific Affairs noted that glass ionomer sealants are an option for consideration when isolation is

compromised.¹¹ To further improve the cost-benefit ratio of sealant treatment, the American Academy of Pediatric Dentistry has discussed a risk-based use of sealants. Despite the considerable benefits of sealants, the long-term success of sealant therapy is dependent upon consistent follow up and repair when necessary. One-time sealant placement does not impart long-term caries protection unless the sealant remains in place and intact.¹² Dental hygienists have played an important part in the ongoing assessment of sealant integrity by evaluation at regular dental hygiene re-care visits.

Given the fact that ingestion of sugars and other fermentable carbohydrates at high frequency plays a pivotal role in caries development, dental hygienists have utilized dietary counseling and home care instruction for many years with the hope of helping patients reduce or restrict related acid exposures. However, today's reality is that Americans are consuming sugars in record amounts. In 2007 the average American consumed 100.6 pounds of sugar per year, or 1.9 pounds per week.¹³ Annual soft drink consumption in 2005 reached nearly 54 gallons per capita, or slightly more than 1 gallon per week per person, bringing with it a host of nutritional, as well as dental, concerns.^{14,15} These trends were confirmed by a study

comparing consumption of sugar sweetened beverages by adolescents via NHANES data during the years 1988 to 1994 and 1999 to 2004. This data confirmed that adolescents from the 1999 to 2004 study cohort consumed approximately 7% more sugar sweetened beverage serving equivalents per day.¹⁶

Although mechanical biofilm removal, fluoride, dental sealants and nutritional counseling have all been vitally important parts of disease prevention, they have not yielded the level of caries risk reduction that oral health care providers have been searching for on behalf of our patients. Current science suggests that there are updated treatment protocols based on the medical model of disease assessment and management, which can improve the oral health of patients.^{17,18}

The Science and Implementation of Caries Management by Risk Assessment into Practice

The traditional method of treating dental caries was to restore resulting damage to tooth structure and return the dentition to proper form and function. In this model preventive measures often only included oral hygiene instruction and reminding the patient not to ingest refined sugar. Over the last 2 decades, science has revealed that the caries process and treatment is more complex than can be managed by this traditional model alone.

Caries management by risk assessment (CAMBRA) is an evidence-based approach to preventing, reversing and, when necessary, repairing early damage to teeth us-

Figure 1: The Caries Imbalance

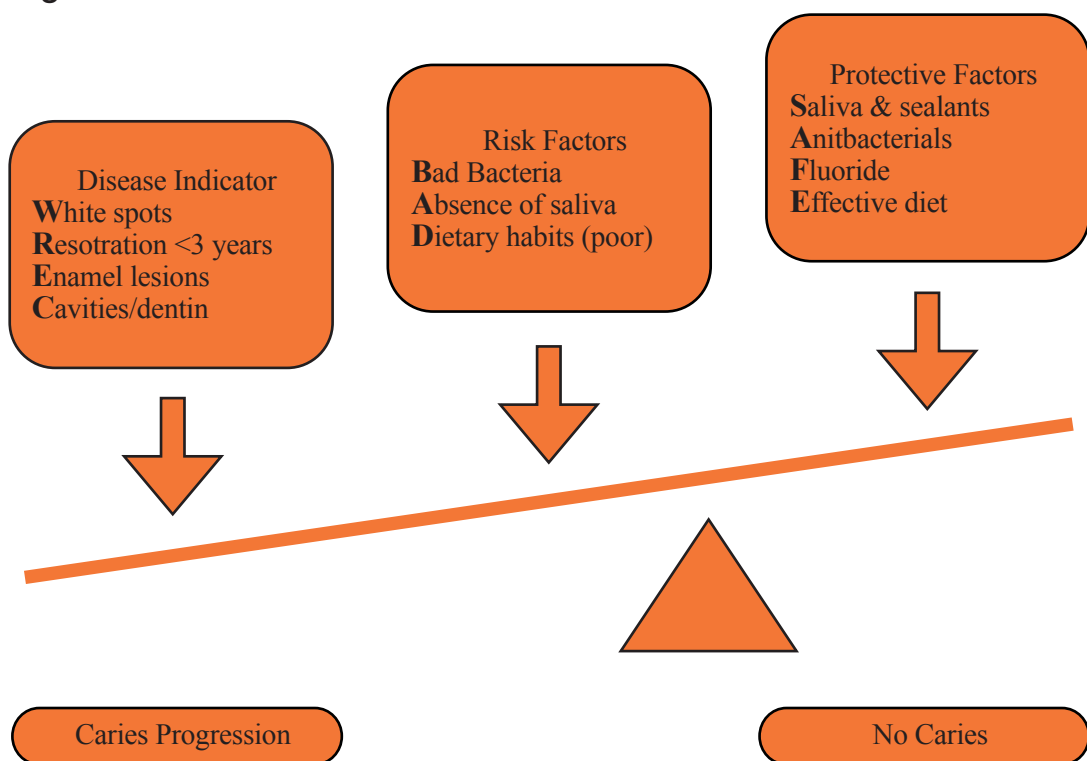
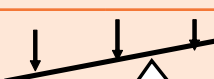


Figure 1 illustrates the caries “imbalance.” The balance amongst disease indicators, risk factors and protective factors determines whether dental caries progresses, halts or reverses. Cavities/dentin refers to frank cavities or lesions to the dentin by radiograph. Restorations <3 years means restorations placed in the previous 3 years. This figure has been updated from previous version of the “caries balance” with the very important addition of the disease indicators. If these indicators are present they weigh heavily on the side of predicting caries progression unless therapeutic intervention is carried out. The leading letters that help to remember the imbalance (WREC, BAD, SAFE) have been added, as well as sealants as a protective factor. Dietary habits (poor) indicate frequent ingestion of fermentable carbohydrates (greater than 3 times daily between meals).

ing minimally invasive restorative techniques.^{19,20} In contrast to traditional management, this contemporary model places emphasis on the whole disease process, rather than just the cavitated stage of lesion progression. A number of organizations have developed protocols based on this assessment, diagnosis and treatment methodology. Among them are the American Dental Association,²¹ the American Academy of Pediatric Dentists²² and the California Dental Association (CDA),^{17,23} which dedicated 4 complete journals to the subject. The first 2 issues of the CDA Journal, February and March 2003, summarized the current science of caries management. In October and November 2007, 2 additional issues were published, which focused on practical implementation of caries management by risk assessment. The CDA has generously made these journals available online (www.cdafoundation.org/journal). The October 2007 issue contains caries risk assessment forms for both the pediatric¹⁷ and adult patients, protocols and product examples that can be downloaded for use in practice.²³ The November issue may be of particular interest to dental hygienists as it contains articles addressing the role of allied health professionals in implementation.^{24,25} All 4 of these journal issues may be downloaded for additional CAMBRA information and to access forms, tables and figures for use in practice.

CAMBRA differs from the traditional restorative approach in treating dental decay by assessing each

Table 1: Caries Risk Assessment Form for Ages 6 Years Through Adult

Patient Name: _____ CHART #: _____ DATE: _____			
Assessment Date: Is This (please circle) Baseline or Recall			
Disease Indicators (Any one YES signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Cavities/radiograph to dentin	YES		
Approximal enamel lesions (E1, E2) (by radiograph)	YES		
White spots on smooth surfaces (Eo)	YES		
Restorations last 3 years	YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			YES
Fluoride toothpaste at least once daily			YES
Fluoride toothpaste at least 2x daily			YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used 1 week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			
VISUALIZE CARIES BALANCE (Use circled indicators/factors above) (EXTREME RISK = HIGH RISK + SEVERE XEROSTOMIA) CARIES RISK ASSESSMENT (CIRCLE): EXTREME HIGH MODERATE LOW 			
Doctor signature/#: _____		Date: _____	

patient for their unique individual risk factors, using the caries balance method first described by Featherstone.²⁶ Figure 1 illustrates the analogy of the “balance,” where disease indicators and pathogenic factors of a patient are weighed against the competing protective factors. The dynamic interaction of these 2 sides of the balance determines risk for future disease. By evaluating the caries balance of a patient, a clinician can determine what behaviors are increasing a patient’s risk for disease and take corrective action. This strategy lead to the development of an evidence-based questionnaire form to measure caries risk and to determine effective treatment options based on that risk (Table 1). Utilizing this new protocol, it has become possible to develop a treatment plan designed to reduce cavitation, arrest decay by stopping demineralization or reverse the caries process via remineralization.²⁷ The CAMBRA approach has proven successful in a recent blinded randomized clinical trial when compared to the traditional restorative approach.²⁸

How the Dental Hygienist May Implement CAMBRA

In this new paradigm of caries management, CAMBRA includes innovative procedures such as saliva assessment, bacterial culturing, a broader choice of therapeutic interventions and ongoing patient data collection (caries risk assessment) to properly diagnose and manage the disease of caries. These duties are best implemented utilizing a dental team approach.^{24,25} A dental assistant trained in CAMBRA pro-

Table 2: Caries Management by Risk Assessment (CAMBRA) C

Risk Level ####**	Frequency of Radiographs	Frequency of Recall Exams	SalivaTest (Saliva Flow & BacterialCulture)	Antimicrobials C Xylitol
Low Risk	Bitewing radiographs every 24–36 months	Every 6–12 months to reevaluate caries risk.	May be done as a baseline reference for new patients	Per saliva test if c
Moderate Risk	Bitewing radiographs every 18–24 months	Every 4–6 months to reevaluate caries risk.	May be done as a baseline reference for new patients or if there is suspicion of high bacterial challenge and to assess efficacy and patient cooperation	Per saliva test if c (6–10 grams/day) candies. Two tabs two candies four
High Risk*	Bitewing radiographs every 6–18 months or until no cavitated lesions are evident.	Every 3–4 months to reevaluate caries risk and apply fluoride varnish.	Saliva flow test and Bacterial culture initially and at every caries recall appt. to assess efficacy and patient cooperation.	Chlorhexidine gl 10 ml rinse for o daily for one wee Xylitol (6–10 gra or candies. Two t two candies four
Extreme Risk** (High risk plus dry mouth)	Bitewing radiographs every 6 months or until no cavitated lesions are evident.	Every 3 months to reevaluate caries risk and apply fluoride varnish.	Saliva flow test and bacterial culture initially and at every caries recall appt. to assess efficacy and patient cooperation.	Chlorhexidine 0.1 CHX in water bas rinse for one minu one week each mo (6–10 grams/day) candies. Two tabs candies four times

*Patients with one (or more) cavitated lesion(s) are high risk patients. ** Patients with one (or more) cavitated lesion(s) are extreme risk patients. Existing smooth surface lesions that do not penetrate the DEJ and are not cavitated are to be treated with restorative materials until caries progression is controlled. Patients with appliances (RPDs, Orthodontics) require excellent oral hygiene. Antimicrobial therapy to be done in conjunction with restorative work ### For all risk levels

col may assist patients with the caries risk assessment form (Table 1), collect diagnostic data (including salivary testing) and provide initial patient education. The dental hygienist may play a key role in planning treatment recommendations based on the dental hygiene examination and data provided by CAMBRA diagnosis and assessment tools. As with all other areas of preventive care, dental hygienists should be actively involved in using the evidence gathered to determine an intervention plan includ-

ing treatment and products unique to the patient’s caries risk and caries balance, establishment of ongoing care frequency, reinforcement of at-home protocol implementation and treatment modifications based on future assessment or reevaluation.

An example of how an intervention plan may be developed based upon the caries risk of the patient was recently published by Jenson⁴ and is summarized in Table 2. This table suggests how the appropriateness of different interventions such

Clinical Guidelines for Patients 6 years and Older

Chlorhexidine	Fluoride	pH Control	Calcium Phosphate Topical Supplements	Sealants (Resin-based or Glass Ionomer)
None	OTC fluoride-containing toothpaste twice daily. after breakfast and at bedtime. Optional: NaF varnish if excessive root exposure or sensitivity.	Not Required	Not Required Optional: for excessive root exposure. Or sensitivity	Optional
None Xylitol gum or 10 mg of gum or 10 times daily	OTC fluoride-containing toothpaste twice daily plus: 0.05% NaF rinse daily. Initially, 1-2 app of NaF varnish; 1 app at 4-6 month recall.	Not Required	Not Required Optional: for excessive root exposure or sensitivity	As per ICDAS Sealant Protocol
Sodium bicarbonate 0.12% (one minute brush each month (10 mg/day) gum or 10 tabs of gum or 10 times daily	1.1% NaF toothpaste twice daily instead of regular fluoride toothpaste. Initially, 1-3 app of NaF varnish; 1 app at 3-4 month recall.	Not Required	Optional Apply calcium/phosphate paste several times daily	As per ICDAS Sealant Protocol
0.2% (preferably 10 ml rinse) 10 ml daily for 1 month. Xylitol gum or 10 mg of gum or 10 times daily	1.1% NaF toothpaste twice daily instead of regular fluoride toothpaste. Initially, 1-3 app. NaF varnish; 1 app at 3 month recall.	Acid neutralizing rinses as needed if mouth feels dry, after snacking, bedtime and after breakfast. Baking soda gum as needed	Required Apply calcium/phosphate paste twice daily	As per ICDAS Sealant Protocol

Sealants and severe xerostomia are extreme risk patient *** All restorative work to be done with the minimally restorative should be treated chemically not surgically. For extreme risk patients use holding care with glass ionomer cement and oral hygiene together with intensive fluoride therapy. e.g. High fluoride toothpaste and fluoride varnish every 3-4 months. Risk levels: Patients must maintain good oral hygiene and a diet low in frequency of fermentable carbohydrates.

as frequency of radiographs and periodic exams, saliva test, antibacterials, topical fluoride, pH control, calcium phosphate and sealants may vary depending on caries risk of the patient.

The following is a brief summary of some of products commonly used to intervene in the caries process:

- Topical fluoride: over-the-counter (OTC) and prescription high fluoride containing dentifrices such as Prevident (Colgate Oral Pharmaceuticals, New York, NY) or Control Rx (3M ESPE,

St. Paul, MN), OTC 0.05% sodium fluoride rinses such as Act (ACT Products, Chattanooga, TN) or Fluorigard (Colgate Oral Pharmaceuticals, New York, NY), prescription 0.2% sodium fluoride rinses such as Oral-B Fluorinse (Procter & Gamble Company, Cincinnati, Ohio) and high concentration 5% sodium fluoride varnish such as Duraflor (A.R. Medicom Inc., Lachine, Québec) or Vanish (3M ESPE, St. Paul, MN)²⁹

- Resin-based and Glass Ionomer

Sealants:^{11,18,30} Resin based materials are retained via a micro-mechanical bond. Glass Ionomer sealants utilize a chemical ion exchange bond and have fluoride releasing properties³¹

- Xylitol products such as chewing gum and mints have been shown to reduce dental caries³² and the vertical transmission of caries pathogens from mother to child^{33,34}

- Antibacterials may include agents such as chlorhexidine,^{35,36} (Periogard, Colgate Oral Pharmaceuticals, New York, NY and Peridex, 3M ESPE, St. Paul, MN) or iodine such as Betadine (Purdue Products, Stamford, CT)³⁷

- Calcium-phosphate based products may be used for sensitivity, remineralization and for patients with reduced salivary flow³⁸

- pH neutralizing products, such as sodium bicarbonate rinses, Cari-Free rinses and neutralizing gel, Denclude desensitizing toothpaste (Colgate Oral Pharmaceuticals, New York, NY) and ProClude desensitizing prophylaxis paste (Colgate Oral Pharmaceuticals, New York, NY) may aid in combating acidity when salivary flow is reduced³⁹



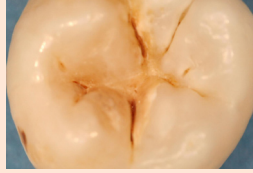
- Emerging products³⁹ such as casein phosphopeptide (CCP) and amorphous calcium phosphate (ACP) products (MI Paste, GC America, Inc. Alsip, IL) have been demonstrated to show delivery of calcium and phosphate to enamel surfaces⁴⁰ and amorphous, calcium sodium-phosphosilicate (NoveMin, NovaMin Technology Inc, Alachua, FL)^{41,42} to aid in fortifying tooth structure. The CariFree system (Oral Biotech, Albany OR) presents

a combination of tools to screen for caries susceptibility, and facilitate rapid bacterial testing. This brief list of products provides only a few examples of those available.

The growing variety of caries-related interventions requires a well trained CAMBRA team. Given the dental hygienist's training in evidence-based evaluation of preventive care strategies and products, additional opportunity to bring knowledge and training to the dental team has presented itself with this new treatment philosophy.

For effective management of caries as a curable, preventable infectious disease, caries activity and caries risk must be assessed at regular intervals and the severity of lesion progression monitored so that treatment methods can be adjusted accordingly for ideal results.⁴³ Though this risk assessment approach differs somewhat with how dentistry has historically viewed and structured compensation for dental services, third party carriers are beginning to see the benefit of this model and compensate accordingly. The ADA Current Dental Terminology book (CDT7) for 2007 to 2008 contains codes for a number of preventive services, including Caries Susceptibility Testing (D 0425), Bacteriology Studies (D 0415), Oral Evaluation Patient (less than 3 years), Counseling Primary Caregiver (D0145) and Topical Fluoride Application for Therapeutic Measures Moderate to High-risk Caries Patient (D 1206). From a business standpoint, CAMBRA protocol has been recognized as good for both practices and patients.²⁴

Table 3: Occlusal Protocol***




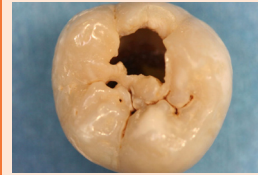
ICDAS code	0	1	2
			
Definitions	Sound tooth surface; no caries change after air drying (5 sec); or hypoplasia, wear, erosion and other non-caries phenomena.	First visual change in enamel; seen only after air drying, or colored change "thin" limited to the confines of the pit and fissure area.	Distinct visual change in enamel; seen when wet, white or colored, "wider" than the fissure/fossa.
Histologic Depth	Lesion depth in P/F was 90% in the outer enamel with only 10% into dentin.	Lesion depth in P/F was 50% inner enamel and 50% into the outer 1/3 dentin/	Lesion depth in P/F with 77% in dentin.
Sealant/restoration Recommendation for Low Risk	Sealant Optional DIAGNOdent may be helpful	Sealant Optional DIAGNOdent may be helpful	Sealant Optional or Caries Biopsy if DIAGNOdent is 20-30
Sealant/restoration Recommendation for Moderate Risk	Sealant Optional DIAGNOdent may be helpful	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended or Caries Biopsy if DIAGNOdent is 20-30
Sealant/restoration Recommendation for High Risk *	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended or Caries Biopsy if DIAGNOdent is 20-30
Sealant/restoration Recommendation for Extreme Risk **	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended or Caries Biopsy if DIAGNOdent is 20-30

* Patients with one (or more) cavitated lesion(s) are high risk patients. ** Patients with one (or more) cavitated lesion(s) are extreme risk patients. *** All sealants and restorations to be done with a minimally invasive philosophy in mind. Sealants are defined as a restorative material that has one part of the preparation in dentin and the preparation extends to a second surface (note: the second surface should have the most conservatively prepared fissures for proper bonding. Glass ionomer should be considered if bonding is not possible. Patients should be given a choice in material selection.

Describing different stages of occlusal decay can be problematic due to the morphology of pits and fissures. A recently proposed nomenclature system, the International Caries Detection and Assessment System (ICDAS), has been created to aid in such description and treatment planning (Table 2). For example, the occlusal pits and fissures are coded based on appearance using a

numeric code from 0 to 6 that correlates clinical appearance with a definition that has been documented histologically.⁴⁴ Jensen et al published a protocol using this ICDAS information based on the caries risk of the patient which may help guide the clinician in their treatment planning decisions (Table 3).¹⁸

Included in Table 3 is laser fluorescence technology, which can be

3	4	5	6
			
Localized enamel breakdown, with no visible dentin or underlying shadow; discontinuity of surface enamel, widening of fissure.	Underlying dark shadow from dentin, with or without localized enamel breakdown.	Distinct cavity with visible dentin; frank cavitation involving less than half of a tooth surface.	Extensive distinct cavity with dentin; cavity is deep and wide involving more than half of the tooth
Lesion depth in P/F with 88% into dentin.	Lesion depth in P/F with 100% in dentin.	Lesion depth in P/F 100% reaching inner 1/3 dentin	
Sealant or Minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant or Minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant or Minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant or Minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration

and lesion(s) and xerostomia are extreme risk patients

as confined to enamel. Restoration is defined as in dentin. A two surface restoration is defined as a preparation where the surface does not have to be in dentin). A sealant can be either resin-based or glass ionomer. Resin-based sealants are used where the enamel is immature, or where fissure preparation is not desired, or where rubber dam isolation is

used to help estimate the extent of occlusal decay. Although such laser fluorescence devices as the DIAGNO-DENT (Kavo, Charlotte, NC) may be used to assist in the decision making process of certain carious lesion presentations, research has indicated that they should not be used as the sole means of caries detection, but rather, as an adjunct to traditional forms of detection.⁴⁵⁻⁴⁷

The Contemporary Role of the Preventive Team

Implementing CAMBRA protocols in dental hygiene practice has provided a format for individualized treatment based upon a risk-assessment. A collaborative team of the dental hygienist, trained assistant and dentist is believed to have the greatest ability to successfully ini-

tiate CAMBRA protocols in the practice. Referral relationships with nutritional counselors, nutritionists or registered dieticians may also be beneficial and productive. Together, these allied health professionals, working with the dentist, may take responsibility for review of the medical history, risk assessment, radiographs, intraoral photos, saliva assessment and bacterial testing, treatment planning, patient education, fluoride varnish, sealants and recommendation of appropriate home care regimens. Using the team approach in delivering these services is the foundation for moving towards a more comprehensive and individualized treatment plan for the patient.

Successful integration of CAMBRA depends not just on the dental hygienist, but the entire practice. The key to successful implementation is educating the patients and team in the value of prevention and early therapeutic intervention. The dental hygienist's role in clinical practice has always supported and encouraged behavioral changes that will last a lifetime. Integrating CAMBRA into the dental hygiene process of care is a natural progression of evidence-based practice.^{24,25}

As with any care a practice provides, the entire dental team must understand and support the CAMBRA treatment methodology for it to be truly successful. The dental hygiene profession has a significant opportunity to move this new information forward by demonstrating the professional roles of educators, researchers, clinicians and advocates of change on behalf of our patients.⁴⁸

Integrating significant paradigm shifts in treatment philosophy and methodology is challenging. However, most professionals will agree that the concepts of dental disease and the practice standards for treating it are vastly different today than they were even 10 years ago. Dental hygienists can be leaders in the implementation of CAMBRA. In doing so, we honor the past as den-

tistry's first preventive care "specialists" and contribute to a future of exciting new preventive strategies and improved patient oral health outcomes.

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References

1. About ADHA, ADHA History—Part One—Founding the Dental Hygiene Profession. American Dental Hygiene Association [Internet]. 2004 [cited 2008 May 29]. Available from: <http://www.adha.org/aboutadha/history.htm>
2. Ciancio S. Improving oral health: current considerations. *J Clin Periodontol.* 2003;30(Suppl 5):4–6.
3. Professionally applied topical fluoride: evidence-based clinical recommendations. *J Am Dent Assoc.* 2006;137(8):1151–1159.
4. Recommendations for using fluoride to prevent and control dental caries in the United States. Center for Disease Control and Prevention [Internet]. 2001 [cited 2008 July 24]. Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5014a1.htm>
5. Community Water Fluoridation Status Now Reaches Nearly 70 percent of U.S. Population. Department of Health and Human Services, Centers for Disease Control and Prevention [Internet]. 2009 [cited 2008 October 18]. Available from: http://www.cdc.gov/fluoridation/statistics/cwf_status.htm
6. Seppä L. Fluoride varnishes in caries prevention. *Med Princ Pract.* 2004;13(6):307–311.
7. Helfenstein U, Steiner M. Fluoride varnishes (DuraPhat): a meta-analysis. *Community Dent Oral Epidemiol.* 1994;22(1):1–5.
8. Forrest JL, Horowitz AM, Shmueli Y. Caries preventive knowledge and practices among dental hygienists. *J Dent Hyg.* 2000;74(3):183–195.
9. Gershen JA. *Geriatric dentistry and prevention: research and public policy.* Adv Dent Res. 1991;5:69–73.
10. Surveillance for Dental Caries, Dental Sealants, Tooth Retention, Edentulism, and Enamel Fluorosis – United States, 1988–1994 and 1999–2002. Beltran-Aguilar E, Barker L, Canto M, et al. Center for Disease Control MMWR [Internet]. 2005 [cited 2009 February 14]. Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5403a1.htm>
11. Beauchamp J, Caufield PW, Crall JJ, et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants: a report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc.* 2008;139(3):257–268.
12. Feigal RJ, Donly KJ. The use of pit and fissure sealants. *Pediatr Dent.* 2006;28(2):92–98,143–150.
13. Sugar and sweeteners: data tables (tables 51, 52 and 53). U.S. Department of Agriculture [Internet]. 2008 [cited 2008 May 29]. Available from: <http://www.ers.usda.gov/Briefing/Sugar/data.htm>
14. Blum JW, Jacobsen DJ, Donnelly JE. Beverage consumption patterns in elementary school aged children across a two-year period. *J Am Coll Nutr.* 2005;24(2):93–98.
15. Soft drink facts. What America drinks: our favorite beverages. American Beverage Association [Internet]. 2007 [cited 2008 May 29]. Available from: <http://www.ameribev.org/all-about-beverage-products-manufacturing-marketing-consumption/what-america-drinks/index.aspx>
16. Bremer A, Auinger P, Byrd R. Sugar sweetened beverage intake trends in U.S. Adolescents and Their Association with Insulin Resistance-Related Parameters. *Journal of Nutrition and Metabolism.* 2009(2010):Article ID 196476, 8 pages.
17. Ramos-Gomez FJ, Crall J, Gansky SA, Slayton RL, Featherstone JD. Caries risk assessment appropriate for the age 1 visit (infants and toddlers). *J Calif Dent Assoc.* 2007;35(10):687–702.
18. Jenson L, Budenz AW, Featherstone JD, Ramos-Gomez FJ, Spolsky VW, Young DA. Clinical protocols for caries management by risk assessment. *J Calif Dent Assoc.* 2007;35(10):714–23.
19. Young DA, Featherstone JD, Roth JR, et al. Caries management by risk assessment: implementation guidelines. *J Calif Dent Assoc.* 2007;35(11):799–805.
20. Young DA, Featherstone JD, Roth JR. Curing the silent epidemic: caries management in the 21st century and beyond. *J Calif Dent Assoc.* 2007;35(10):681–685.
21. ADA Risk Assessment Forms – Tooth Decay and Dental Caries. The American Dental Association [Internet]. [Cited 2009 February 26]. Available from: http://www.ada.org/prof/resources/topics/topics_caries_instructions.pdf

22. Establishing a Dental Home: Using the American Academy of Pediatric Dentists Caries–Risk Assessment Tool (CAT) as the First Step. American Academy of Pediatric Dentistry [Internet]. 2007 [cited 2009 February 27]. Available from: <http://www.aapd.org/foundation/pdfs/CAT.pdf>
23. Featherstone JD, Domejean–Orliaguet S, Jenson L, Wolff M, Young DA. Caries risk assessment in practice for age 6 through adult. *J Calif Dent Assoc.* 2007;35(10):703–707, 710–713.
24. Gutkowski S, Gerger D, Creasey J, Nelson A, Young DA. The role of dental hygienists, assistants, and office staff in CAMBRA. *J Calif Dent Assoc.* 2007;35(11):786–789, 792–793.
25. Kutsch VK, Milicich G, Domb W, Anderson M, Zinman E. How to integrate CAMBRA into private practice. *J Calif Dent Assoc.* 2007;35(11):778–785.
26. Featherstone JD. The caries balance: contributing factors and early detection. *J Calif Dent Assoc.* 2003;31(2):129–133.
27. Young DA. New caries detection technologies and modern caries management: Merging the strategies. *Gen Dent.* 2002;50(4):320–331.
28. Featherstone JDB, Gansky SA, Hoover CI, et al. A randomized clinical trial of caries management by risk assessment. *Caries Res.* 2005;39:295 (abstract #25).
29. Hausen H. Benefits of topical fluorides firmly established. *Evid Based Dent.* 2004;5(2):36–37.
30. Young DA. The use of glass ionomers as a chemical treatment for caries. *Pract Proced Aesthet Dent.* 2006;18(4):248–250.
31. Hicks MJ, Flaitz CM. Occlusal caries formation in vitro: comparison of resin–modified glass ionomer with fluoride–releasing sealant. *J Clin Pediatr Dent.* 2000;24(4):309–314.
32. Anderson M. Chlorhexidine and xylitol gum in caries prevention. *Spec Care Dentist.* 2003;23(5):173–176.
33. Söderling E, Isokangas P, Pienihäkkinen K, Tenovu J. Influence of maternal xylitol consumption on acquisition of mutans streptococci by infants. *J Dent Res.* 2000;79(3):882–887.
34. Hujoel PP, Mäkinen KK, Bennett CA, et al. The optimum time to initiate habitual xylitol gum–chewing for obtaining long–term caries prevention. *J Dent Res.* 1999;78(3):797–803.
35. Kidd EA. Role of chlorhexidine in the management of dental caries. *Int Dent J.* 1991;41(5):279–286.
36. Baca P, Muñoz MJ, Bravo M, Junco P, Baca AP. Effectiveness of chlorhexidine–thymol varnish for caries reduction in permanent first molars of 6–7–year–old children: 24–month clinical trial. *Community Dent Oral Epidemiol.* 2002;30(5):363–368.
37. Lopez L, Berkowitz R, Spiekerman C, Weinstein P. Topical antimicrobial therapy in the prevention of early childhood caries: a follow–up report. *Pediatr Dent.* 2002;24(3):204–206.
38. Reynolds EC, Cain CJ, Webber FL, et al. Anticariogenicity of calcium phosphate complexes of tryptic casein phosphopeptides in the rat. *J Dent Res.* 1995;74(6):1272–1279.
39. Spolsky VW, Black BP, Jenson L. Products–old, new, and emerging. *J Calif Dent Assoc.* 2007;35(10):724–737.
40. Reynolds EC. Remineralization of enamel subsurface lesions by casein phosphopeptide–stabilized calcium phosphate solutions. *J Dent Res.* 1997;76(9):1587–1595.
41. Wefel JS. NovaMin: likely clinical success. *Adv Dent Res.* 2009;21(1):40–43.
42. Burwell AK, Litkowski LJ, Greenspan DC. Calcium sodium phosphosilicate (NovaMin): remineralization potential. *Adv Dent Res.* 2009;21(1):35–39.
43. Anusavice KJ. Present and future approaches for the control of caries. *J Dent Educ.* 2005;69(5):538–554.
44. Pitts N. “ICDAS” – an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. *Community Dent Health.* 2004;21(3):193–198.
45. Lussi A, Imwinkelried S, Pitts N, Longbottom C, Reich E. Performance and reproducibility of a laser fluorescence system for detection of occlusal caries in vitro. *Caries Res.* 1999;33(4):261–266.
46. Bader JD, Shugars DA. A systematic review of the performance of a laser fluorescence device for detecting caries. *J Am Dent Assoc.* 2004;135(10):1413–1426.
47. Laser fluorescence in caries diagnosis – May 28, 2007. AADC Positions Committee Positions Statement, American Association of Dental Consultants [Internet]. 2008 [cited 2009 February 16]. Available from: <http://aad.org/site/articles/laser–position.pdf>
48. Education and careers. American Dental Hygienists’ Association [Internet]. [Cited 2008 June 4]. Available from: <http://www.adha.org/careerinfo/dhcareers.htm>