



DR. JOSEPH WHITEHOUSE

This month, two WCMID members (a father/son team, actually) present a detailed look at CAMBRA and explain why it's "treat the cause" approach should be standard of care in all dental practices. —J.W.



This monthly column is co-sponsored by DPR and The World Congress of Minimally Invasive Dentistry. It is edited by Congress past-president Dr. Joseph Whitehouse.

Manage caries: a minimally invasive approach

By V. Kim Kutsch, DMD and Carson Kutsch, DDS.

Dental caries is a pandemic infection associated with the onset of enamel demineralization. Previously in this column, Drs. Young, Buchanan, Lubman and Budenz discussed the concept of dental caries as a bacterial infection, and proposed treatment of the infection in addition to treatment of the signs and symptoms as a standard of care. It is important to recognize that caries is the disease, or bacterial infection, now recognized as a biofilm disease, while a carious lesion, cavitation or cavity, is merely a symptom of this disease. Thus, a medical model approach to management of dental caries by risk assessment and treatment of the bacterial infection has been developed and labeled CAMBRA (caries management by risk assessment) as an acronym. This concept deserves further discussion here.

History of caries pathology

Bacterial plaque and the associated demineralization of enamel directly below the plaque were first reported by James Leon Williams in 1921. Shortly thereafter, Strep mutans and Lactobacilli were directly implicated in the formation of cavitated carious lesions, the clinical expression or symptom of the bacterial infection. Since the introduction of the first disease model of caries, the primary treatment has focused on surgical intervention of the symptoms, but the concept of recognizing and treating the bacterial infection has early roots.

As early as 1924, G.V. Black proposed that dentistry should include an understanding of the pathology and nature of caries rather than focus principally on surgical intervention. However, since that time the dental profession has continued to concentrate on surgical intervention, rather than addressing the bacterial infection as a disease proper. Caries is a steady-state disease with a variable expression over time. Surgical intervention of a steady-state disease is inefficient, leading to continual treatment of the symptoms while never really making progress against the etiology of the symptoms.¹

Biofilm: guilty as charged

Progress is being made in understanding caries as a biofilm disease. We now recognize dental plaque as a sophisticated biofilm.² This biofilm develops rapidly on the teeth and forms a protective coating that reduces wear and maintains ionic stability with the enamel surface supporting the demineralization/remineralization process that maintains the integrity of the enamel.

In a normal, healthy oral biota, the biofilm begins developing immediately with precipitation of salivary proline-rich casein-micelle globules. Calcium ions bridge between the globules and within 2 hours, streptococcus bacteria adhere to the pellicle with exopolysaccharides and form a multilayered protein structure. Pioneering species generally include *S. sanguis*, *gordonii*, with co-aggregation of *A. naeslundii*. The biofilm then becomes anaerobic, consists of multiple bacterial species, and achieves structure and function. This climax community may be only 25 to 100 microns thick, develops in 24 hours, and be stable for long periods.³ While it is generally accepted that "clean" teeth do not decay, normal brushing and flossing does not remove this pellicle or thin biofilm. The presence of thick plaque does not necessarily result in cavitation, and a clean appearing tooth may have a cariogenic biofilm.

Under certain conditions, the normal, healthy biofilm may become replaced with a cariogenic biofilm. In a normal biofilm, acidogenic/aciduric bacteria like Mutans streptococci and Lactobacilli account for about 1% of the bacteria, while in a cariogenic biofilm these bacteria dominate the community and make up to 96% of the bacteria. At this point, the pH of the biofilm

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The hierarchy of caries risk Treatment should be recommended according to patients' individual risk assessment. (A) This high-risk patient with high active caries process has numerous active lesions that progressing rapidly to destroy teeth. (B) This high-risk patient with low active caries process has multiple risk factors but presents with few white-spot lesions; the open cavitations have been progressing over 20 years. (C) This moderate risk patient has numerous white-spot lesions that will lead to cavitations if left untreated. (D) This low-risk patient has no open cavitations, no white-spot lesions, and low risk factors.

Risk assessment QUESTIONS

Does the patient seek regular re-care appointments?

What is their decay experience like?

Have they had any cavitations restored in the past three years?

Does the patient demonstrate good oral hygiene with daily brushing and do they really floss?

What type of toothpaste do they use, and does it contain fluoride?

Do they also use an over-the-counter fluoride rinse?

Are there visible active cavitations, white spot lesions or evidence of radiographic caries?

What is the patient's attitude toward dentistry and their oral health?

Does the patient snack more than three times per day between meals?

Do they chew gum and drink sodas, and are they sugarless or diet?

Do they use any xylitol based products?

Are they currently using any antimicrobial agents?

(A review of the dietary habits of the patient confirms the presence of fermentable carbohydrates. It is important to determine the frequency of these carbohydrates, the timing, and the type. The frequency and the resulting demineralization/remuneration cycle is more important than the type of snack. How many carbohydrates and how often they are ingested are important factors in risk assessment.)

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becomes acidic, and the low pH favors additional aciduric bacterial species and drives the loss of calcium and phosphate mineral from the enamel⁴. In the low pH biofilm, the cariogenic bacteria have a high metabolic rate and expend a great deal of ATP to pump H⁺ ions out of the cell to maintain intracellular neutrality.⁵ To effectively treat dental caries, not only must the teeth be restored to function, but the cariogenic biofilm needs to be restored to a healthy biofilm.

Beyond treating symptoms

Medical management of dental caries is not a new concept, but has not been reduced to practice by the dental profession on any significant scale. One problem has been a lack of a nationally recognized, validated, and universal agreed upon caries treatment protocol. This is changing.

Most dental schools now incorporate caries risk assessment as a standard practice and the ADA even recognizes the need for risk assessment as a standard of care. Many dental schools are now working together to create universal forms and protocols. The necessary paradigm shift that practicing dentists must now recognize is that treating the symptoms alone does not treat the underlying bacterial infection.⁶ It has been commonly thought by the dental profession that caries control could be accomplished exclusively by eliminating the cavitations, good oral hygiene, and proper diet, with fluoride thrown in for good measure. This treatment model repeatedly demonstrates its ineffec-

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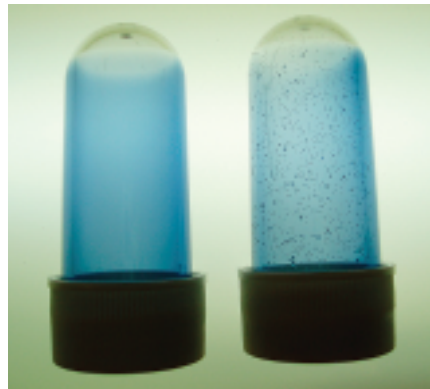
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Cariogenic bacteria screening

ATP bioluminescence is a valuable technique for determining the presence of cariogenic bacteria. After swabbing a tooth (A), the biofilm is cultured (B).

The vial on the left is from a low-risk patient. The vial on the right, from a high-risk patient, shows high counts of *Mutans streptococci* CFUs.



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tiveness and failure with its illogical management of a bacterial infection. Almost all dentists have had the clinical experience with a high risk, high active caries patient, where filling the teeth resulted in only momentary relief of pain and restoration of the teeth to function, while the teeth could not be filled fast enough to prevent new cavitations. They could not keep up with the disease. And most clinicians have also had the experience of providing a makeover to these patients without treating the infection, delivering 20 esthetic veneers and crowns, only to see the patient return a year later with recurrent decay around all of the restorations.

The plaque theory doesn't hold water and the surgical model doesn't work clinically! The infection must be identified, diagnosed, treated and monitored independent or in addition to treating the symptoms. Otherwise, the patient will continue to live with the infection, along with recurring symptoms.

A delicate balance

The Featherstone Caries Balance model (see the graphic on the facing page) includes examining additional necessary factors such as the saliva production and pH, while combining antimicrobials in creating a stable oral environment that results in optimal oral health.⁷ There are numerous protective factors that can be employed to create a healthy balance for a patient, but the first step is getting an accurate diagnosis and disease risk assessment. Caries risk assessment includes examination of the patient's medical history, dental history, diet, saliva, and colony forming units of acidogenic bacteria in the saliva. There are many medications, ranging from antihistamines to anti-hypertensives, that result in reduced salivary function. Other medical conditions such as Sjogren's syndrome often have accompanying xerostomia. A history of radiation therapy to the head and neck may result in reduced salivary function. Drug abuse manifests itself by increasing caries risk. As methamphetamines produce a dry mouth and the addicts frequently crave diets based on simple sugars. In addition, salivary function decreases naturally with advancing age and may result in tipping the caries balance. As taste bud function also decreases with age, senior patients may complicate matters by adding more sugar directly to their food.

Ask the right questions

Several other factors to consider during the medical history review are in regards to whether the patient may have some physical or mental limitations. The dental history is also an important review in determining the patient's caries risk assessment. See the sidebar on page ??? for a list of salient questions.

By adding this detailed information to a thorough oral exam, a clearer picture of the patient's disease status and risk emerges.⁸ During the oral exam, it is im-

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portant to observe the saliva, and to visually assess whether there is adequate saliva.

Other moderate risk factors to consider include exposed root surfaces and deep developmental pits and fissures. If there are enough risk factors present, or the pathogenic risk factors outweigh the protective risk factors, further testing and treatment of the biofilm are recommended.

New weapons

A new approach to diagnosing and treating dental caries requires new language, procedures, instruments, materials and education. Currently available products include standardized caries risk assessment forms, bacterial cultures, and an assortment of xylitol-containing products, fluoride rinses, toothpastes, gums, and mints.

New products include ATP bioluminescence, rapid culture techniques, and oral care products that are antimicrobial in nature. Because the cariogenic bacteria use a tremendous amount of ATP to maintain intracellular neutrality, ATP bioluminescence offers a potential screening test for cariogenic bacteria in the biofilm.^{9,10}

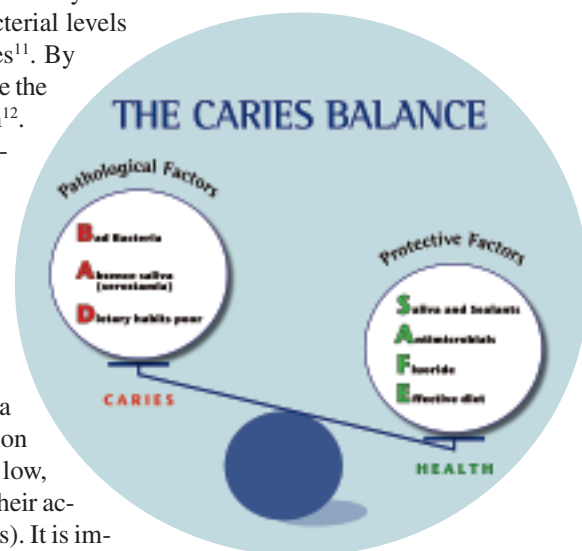
By swabbing the tooth surface and measuring the ATP levels present, the cariogenic potential of the biofilm may be estimated. A quick and simple low cost screening test allows clinicians to routinely monitor caries risk for their patients. While ATP levels are nonspecific and does not identify specific bacteria in the biofilm, it does show promise as an accurate screening test. Rapid cultures are utilized for a number of determinations, and

a rapid culture for Mutans streptococci gives the dentist a valid level of these known pathogens in the patient's biofilm (see photos on previous page). Numerous studies over the past 25 years have established the relationship between these bacterial levels and the incidence, severity, and rate of dental caries¹¹. By monitoring the bacterial levels, clinicians can measure the effectiveness of the caries treatment on the biofilm¹².

New antimicrobial oral care products provide short-term therapy against the cariogenic biofilm and long term maintenance for a healthy biofilm. Most of the currently available oral rinses are low pH, while part of the caries therapy goals should include raising the pH of the biofilm, to favor normal bacteria.

Developing a treatment plan

Combining all of this data, the dentist can develop a caries risk assessment and treatment recommendation for the individual patient. The patient is classified as low, moderate, high, or even extreme risk for caries, and their activity is assessed (see photos on page ?? for examples). It is important that the patient understand the caries balance, and what will be required to not only treat their cavitations but eliminate or control the cariogenic biofilm disease as well. The patient should also understand the nature of the caries balance and that their caries risk factors may change over time. For example, a patient may begin taking a xerostomia producing medication years into the future and they need to understand how this might affect their



The caries balance
Pathologic factors versus protective factors determine caries risk.

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caries balance and oral health. Risk factors change over time, and need to be assessed on an ongoing basis.

All treatment recommendations should be designed around the patient's individual risk assessment. Providing the right protective factors can result in getting the

patient under control or compliant, and in achieving a healthy balance. The protective factors must outweigh the pathologic factors to achieve success. The cavitations need to be treated concurrently with the caries treatment, and depending on the patient, the risk assessment may influence the best choice of restorative ma-

terial. When restoring a high or extreme risk patient, glass ionomer would be the material of choice where-ever possible. The patient might even require treatment stages, involving treating the infection first, followed by treating all cavitations with glass ionomer and achieving and documenting successful compliance before

proceeding to definitive restorations.

Conclusion

While there is yet no standardized, agreed upon and validated regimen currently available for caries treatment, promising validated research is currently underway. Dental schools are working together to standardize care and recommendations. The World Congress of Minimally Invasive Dentistry is committed to educating the profession and the public about the medical model of dentistry. Dental Boards, Public Health and Third-party agencies are examining this issue. Dental journals are staying abreast of current developments as researchers and clinicians continue to collect data. New and promising diagnostic and treatment tools and materials are coming to the market. One thing is certain, without the CAMBRA data, simply diagnosing and treating the patient's cavities with the traditional surgical model is outdated and ineffective, and it does not result in long term health for the patient.

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