

# Minimally Invasive Dentistry - The New Paradigm

*Treating caries in patients like the  
physicians\* we are, not technicians*

**What is Minimally Invasive Dentistry (MID)?  
As defined by the World Congress of  
Minimally Invasive Dentistry: 'MID is  
respecting the health, function and aesthetics  
of oral tissue by preventing disease from  
occurring or intercepting its progress with  
minimal tissue loss.' In this article, we are  
discussing one aspect of dentistry that is a  
top value item in the MID paradigm.**

In a world full of disease and pain, one wonders why we keep treating the symptoms of disease rather than treating the disease itself. We, as dentists, have excelled in the surgical aspects of our profession, and the technological revolution of the last few decades has helped us a lot. Yet, our basic paradigm (i.e. an habitual way of thinking which leads us to do what we do) has not changed dramatically since the early 1900s. Even though the concept of caries being an infection has been known for decades, we haven't changed our way of thinking around it, significantly enough, to cause major change in the way we treat it. That paradigm is what we are changing now.

Dental caries is a pandemic infection in humans associated with loss of tooth structure. 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 the symptom of this disease. Caries Activity is an indication of the number and severity of

the cavitations in that individual at that moment in time. Caries RISK is the cumulative result of factors that have lead to this individual's current state of caries activity and indicates what could happen if nothing changes to manage it. It is a historic analysis that continues into the present and indicates the future. Current factors and behaviors of that individual constitute their Risk level. This medical model management of dental caries by risk assessment has been labeled CaMBRA as an acronym. This concept deserves further discussion here.

### Caries as an Infection

Bacterial plaque biofilm and the associated demineralization of enamel directly below the bio-film 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 first introduction of the disease model, the primary treatment has been focused on surgical intervention of the symptoms. But the concept of recognizing and treating the infection has early roots. GV Black first proposed that dentistry should include an understanding of the pathology and nature of caries rather than focus primarily on surgical intervention as early as 1924.

However since that time, the dental profession has continued to focus 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 continually treating the symptoms while never really making progress against the cause of the symptoms.

Progress is being made in understanding caries as a biofilm disease. We now recognize dental plaque as a sophisticated biofilm. This biofilm develops rapidly on the teeth and forms a protective coating that reduces



Biofilm

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wear, and maintains ionic stability with the enamel surface that supports the demineralization/ remineralization process maintaining the integrity of the enamel. In a normal, healthy mouth, the biofilm begins development immediately with precipitation of salivary praline-rich casein-micelle globules. Calcium ions bridge between the globules and within two 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 25-100 microns thick and may develop in 24 hours and be stable for long periods.<sup>2</sup> While it is generally assumed 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.<sup>3</sup>

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 becomes acidic, and the low pH favors additional aciduric bacterial species and drives the loss of calcium and phosphate mineral from the enamel. In the low pH biofilm, the cariogenic bacteria have a high metabolic rate and expend a great deal of ATP to pump H<sup>+</sup> ions out of the cell to maintain intracellular neutrality.<sup>4</sup> 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.

Medical management of dental caries is not a new concept, but has not been applied in practice by the



High risk patient

dental profession on any significant scale. One of the problems has been that there are no internationally recognized, validated, universally agreed upon caries treatment protocols. That is changing. Many dental schools now incorporate caries risk assessment as a standard practice and even the ADA recognizes the need for risk assessment as a standard. 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. It has been common thought by the dental profession that caries control could be accomplished by eliminating the cavitations, good oral hygiene with the addition of fluoride thrown in for good measure.

This treatment model has repeatedly demonstrated its ineffectiveness and failure. Almost all dentists have had the clinical experience with a high risk, high active caries patient, where filling the teeth resulted in momentary relief of pain and restoration of the teeth to function, but they couldn't fill the teeth fast enough to prevent new cavities. They couldn't keep up with the disease.

Alternatively, they have had the experience of providing a makeover for these patients without treating the infection; providing 20 aesthetic veneers and crowns, only to see the patient return a year later with recurrent decay around all of the restoration. The plaque theory doesn't hold water and the surgical model does not work! The infection must be identified, diagnosed, treated and monitored independent or in addition to treating the symptoms. Otherwise the individual patient will continue to live with the infection, with recurring



High risk patient without caries management

symptoms until they either run out of teeth or die.

### Diagnosing Caries

The Featherstone Caries Balance model includes examining additional necessary factors such as the saliva and combining antimicrobials in creating a stable oral environment that results in health. 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, from antihistamines to anti-hypertensives that result in reduced saliva function. Other medical conditions e.g. 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 also manifests itself by increasing caries risk. Methamphetamines produce a dry mouth and the addicts frequently crave diets based on simple sugars.

Salivary function also decreases naturally with



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By monitoring the bacterial levels, the clinicians can measure the effectiveness of the caries treatment on the biofilm. New antimicrobial oral care products provide short term therapy against the cariogenic biofilm and long term maintenance for a healthy biofilm

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.

Several other factors to consider during the medical history review are 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. 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, 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? It also is important to assess the patient's attitude toward dentistry and their oral health.

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 are more important than the type of snack. Does the patient snack more than three times per day between meals? Do they chew gum and drink sodas, are they sugarless or diet? Do they use any xylitol



Low risk patient

based products, are they currently using any antimicrobial agents? How many carbohydrates and how often they are ingested are important factors in risk assessment.

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**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 achieving a healthy balance**

patient's disease status and risk emerges. During the oral exam it is important to observe the saliva, is there visually adequate saliva? Other moderate risk factors to consider include exposed root surfaces, deep developmental pits and fissures. If there are enough risk factors present, or the pathogenic risk factors outweigh the protective risk factors, it is recommended to do further testing and treatment of the biofilm. 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, ACP (amorphous Calcium Phosphate) creams, fluoride rinses, toothpastes, gums and mints.

New products include ATP bioluminescence, rapid culture 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. 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 non-specific and does not

identify specific bacteria in the biofilm, it does show promise as a 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. Numerous studies over the past 25 years have established the relationship between these bacterial levels and the incidence, severity and rate of dental caries.

By monitoring the bacterial levels, the clinicians can measure the effectiveness of the caries treatment on the biofilm. 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.

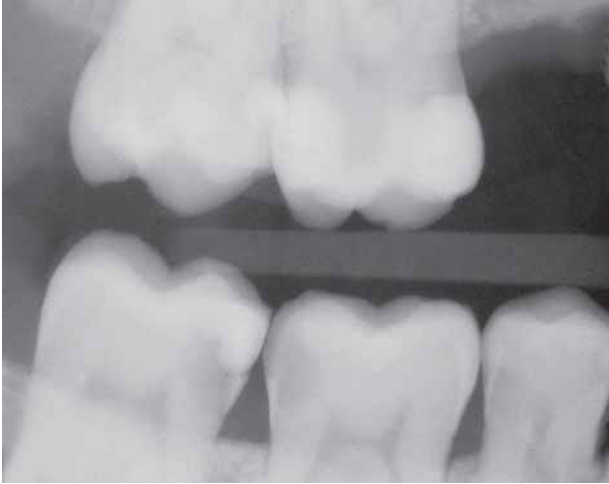
### Discussion

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. It is important that the patient takes responsibility and understands the caries balance, and what will be required to not only treat their cavitations but also eliminate or control the cariogenic biofilm disease as well.

The patient should also understand that their caries risk factors might 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 caries balance and oral health. Risk



Medium risk, high acid caries



Is the filling going to save his problems after one year? No.

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 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 material. When restoring a high or extreme risk patient, glass ionomer would be the material of choice wherever 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, ineffective and

does not result in long term health for the patient. **DA**

\* *phy-si-cian n*

1. *somebody qualified to practice medicine. Also called doctor*
2. *a doctor who diagnoses and treats diseases and injuries using methods other than surgery*

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