

CARIES DISEASE: What It Is and What To Do About It

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Caries Disease

Untreated tooth decay in permanent teeth was the most common of all 291 major diseases and injuries assessed by the 2010 Global Burden of Disease study, affecting 35 per cent of the world population.

Marcenes W et al, Global Burden of Oral Conditions 1990-2010: A Systematic Analysis, J Dent Res 92(7), July 2013



Caries Disease

Dental caries, also known as tooth decay or a cavity, is an **infection, bacterial** in origin, that causes demineralization and destruction of the hard tissues of the teeth (enamel, dentin, and cementum).

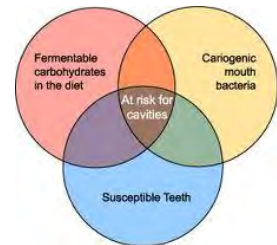
Wikipedia

An infectious microbiological **disease** of the teeth that results in localized dissolution and destruction of the calcified tissues.

Caries Disease

An infectious microbiological disease of the teeth that results in **localized dissolution and destruction** of the calcified tissues.

- Three requirements
 1. Teeth
 2. Bacteria
 3. Food



The Usual Suspects



Pattern Recognition

Slide courtesy of Dr. Kim Kutsch

The Usual Suspects

- **Bacteria:**
 - Over 50 bacteria now identified as potential cariogens
- **Diet:**
 - Americans eat 22.7 tablespoons of sugar per day
 - Americans eat 51 lbs of High Fructose Corn Syrup per year – highest in the world
- **Saliva:** medication induced salivary gland hypofunction
 - 70% of Americans take at least one medication
 - >50% take two or more
 - 20% take five or more

The Usual Suspects

- **Genetics:**
 - Numerous genes are now associated with dental caries
 - A significant genetic association exists between dental caries of the anterior mandibular teeth and LYZL2, which codes a bacteriolytic agent thought to be involved in host defense.
 - A significant genetic association exists between caries of the mid-dentition tooth surfaces and AJAP1 a gene possibly involved in tooth development.

Shaffer JR et al., GWAS of dental caries patterns in the permanent dentition, Dent Res 92(1), Jan. 2013

The Usual Suspects

- **Oral pH and saliva are closely related**
 - Medications
 - Cancer treatment – radiation and/or chemotherapy
 - Sjogren's Syndrome or other autoimmune diseases
 - Diseases like HIV*/AIDS or diabetes
 - Metabolic disturbances
 - Stress and depression
 - Physiological blockage of salivary gland ducts
 - Inadequate hydration and dehydration
 - Dietary and environmental exposure
 - Acidic foods
 - Beverages: sodas, sports/energy drinks, bottled water

pH of bottled water

Find your favorite bottled water and see where it lands on the pH chart	
Product	Approximate pH
Alkaline Mineral Water	8.2 to 9.5
Asia Pacific	7.0 to 8.0
Evian Water	4.0
Dasani Water	4.0
Purified Water	4.0
Aquafina (made by Pepsi)	4.0
Dasani (made by Coke)	4.0
Dasani Pureit Water	4.0
La Bona Water	4.0
Nature's Best Water	4.0
Poligratia	4.0
Furukawa	4.0
Smart Water	4.0
Alkaline Water	4.0
Nature's Choice Ultra and Purified Water	4.5 - 9.0 (depending on season)
Ice Age Chubb Water	4.5
Appalachian Springs Water	5.0
Rock Springs Water	5.0
Pureit American Water	5.5
Danone Spring Water	5.5
Mountain Water	7.0
Crystal Geyser Water	7.0
Deep Park Water	7.0
Rockwell Springs Water	7.0
Geopark Spring Water	7.0
Evian Water	7.4
Fiji Water	7.5
Whole Foods 36.5 Water	7.5
Zap by Pureit Water	7.5
Water Spring Water	7.9
Deep Rock Water	8.0
Dasani Water	8.0

Caries Disease

The caries process

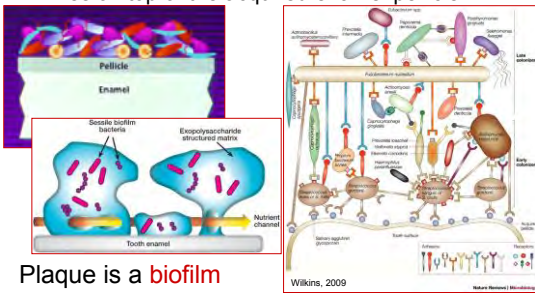
- Plaque, a bacterial film, forms on the teeth
- Acids are produced as byproducts of bacterial metabolism
 - Lactic acids are particularly damaging and are predominantly produced by Mutans streptococci and by Lactobacillus
- These acids demineralize the tooth surface

Marsh PD. Dental plaque as a biofilm: The significance of pH in health and caries. Compend Contin Educ Dent 30(2), 2008

Caries disease

Plaque is a complex microbial community

- Lives on top of the acquired enamel pellicle



Plaque is a **biofilm**

Caries Disease

A **biofilm** is any group of microorganisms in which cells stick to each other on a surface.

- Dental caries is a complex, multifactorial disease with the oral microbial component being a **biofilm**.

Wikipedia

The bacterial components of the biofilm can shift from healthy flora to acidogenic, aciduric bacteria due to changes in

- Diet
- Saliva
- Medications
- Home care



Buscher HJ & Evans LV, Oral Biofilms and Plaque Control, Gordon and Breach Publishing, Philadelphia, 1998

Caries Disease

The bacterial components of the biofilm can shift from healthy flora to acidogenic, aciduric bacteria

A higher mature plaque microbial diversity was seen in caries-active compared to caries-free patients. *Rothia dentocariosa* and *Scardovia inopinata* were absent from all caries-free sites, but appeared in 50% of the caries-active sites.

Thomas RZ, et al. Shifts in the microbial population in relation to in situ caries progression, Caries Res 46(5), 2012

Caries Disease

The caries process

- As the bacterial components of the biofilm begin to shift from a healthy flora to an acidogenic, aciduric bacterial flora,
- The oral pH decreases, which leads to greater demineralization and destruction of tooth structure
- The critical oral pH is 5.5
 - Above pH 5.5, the process is slow and may be easily reversed
 - Below pH 5.5, the process is increasingly fast and logarithmically destructive

Featherstone JDB. The science and practice of caries prevention, JADA Vol 131(7), 2000

Caries Disease

Two key points:

- Mutans streptococci and Lactobacillus are the most commonly found **acidogenic bacteria** in tooth biofilm,
 - Normally <1% of healthy oral biofilm
 - Can account for >96% of the biofilm in low pH-related oral conditions
 - But they are not the only acidogenic bacteria found
- 1. As pH decreases in the biofilm, not only do the numbers of harmful bacteria increase, but **some healthy bacteria convert to harmful acid producing bacteria**

Caries Disease

Two key points:

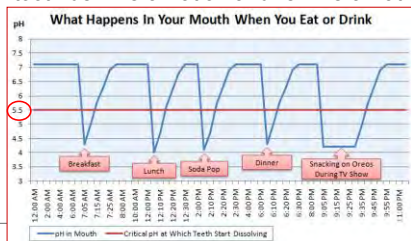
1. As pH decreases in the biofilm, not only do the numbers of harmful bacteria increase, but **some healthy bacteria convert to harmful acid producing bacteria**
- A microbial community consists of a tremendous number of diverse bacteria, but functions as one organism, a 'superorganism'.... We have to get away from this monolithic one-bug-one-disease picture of health, the community is the unit of study.

Buchen L. Microbiology: the new germ theory, Nature 2010

Caries Disease

Two key points:

2. Caries is a continuous, multifactorial process of tooth demineralization and remineralization



Caries Disease

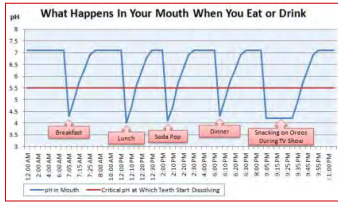
Two key points:

2. Caries is a continuous, multifactorial process of tooth demineralization and remineralization
 - A. This disease process can be stopped, arrested, at any point in time
 - B. Remineralization is possible at any point in time
 - By reversing, or limiting, the extent of salivary pH changes, teeth can be stabilized, and even remineralized
 - C. Until cavitation of the surface occurs, the process may be manageable with medication alone
 - This is one cornerstone of "minimally invasive dentistry"

Jenson L et al. Clinical protocols for caries management by risk assessment, J Calif Dent Assoc 35(10), 2007

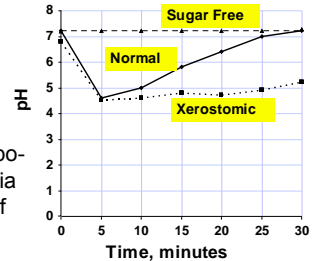
Caries Disease

- Sources of acid/cause of demineralization
- Extrinsic Sources
 - Dietary
 - Bacterial
 - Environmental
 - Medications
- Intrinsic Sources
 - Stomach Acid
 - Bulimia
 - Gastro-Esophageal Reflux Disease (GERD)



Caries Disease

- Sources of buffering/remineralization
- Intrinsic Sources
 - Saliva
- Extrinsic Sources
 - Dietary
- Salivary gland hypofunction/xerostomia is a major cause of caries disease



Caries Disease

- Although caries is generally thought of as a disease of childhood or adolescence, adults clearly have caries disease.
- Certain groups of adults appear to have a higher incidence of caries than do other groups.
 - Many elderly patients
 - Many lower socioeconomic patients

Why?

Caries Disease

- More important: Can we predict who is at increased risk for caries disease?
- Caries risk assessment (CRA), particularly in adults, is anything but an exact science...
 - ...but the science is getting better!

The preventive approach to managing caries disease begins with early lesion detection

A Starting Place: Early Caries Detection



The earlier we can detect a developing lesion, the more likely we can reverse it

Caries Detection/Identification

- Caries Identification Technology
 - Visual inspection
 - Radiographs
 - Caries-indicating dyes
 - Visible light: Fiber optic transillumination (FOTI) and digital imaging fiber optic transillumination (DIFOTI)
 - Light-induced fluorescence
 - Laser-induced fluorescence
 - Electrical conductance
 - Alternating current impedance spectroscopy (ACIST)
 - Ultrasound caries detection
 - Optical Coherence Tomography (OCT) using near infrared (NIR) transillumination
 - Salivary diagnostics

Caries Identification Technology

Visual inspection

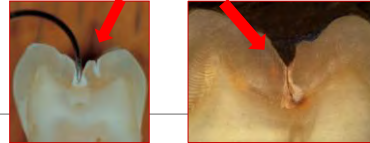
- Looking for defects in tooth surfaces
 - Visual
 - Feeling the surface with an explorer using light pressure
- Looking for color changes in teeth
- Reflecting light through teeth looking for optical transmission differences



Caries Identification Technology

Visual inspection

- Looking for defects in tooth surfaces
 - Feeling the surface with an explorer using light pressure
 - Only 17 – 40% correct
 - Can transfer bacteria to other sites
 - Can damage an intact surface
 - Both false positives and negatives



Caries Identification Technology

Food for thought:

“Too often I have had to perform aggressive, invasive treatment on teeth that I had believed to be healthy. Clearly, the decay had not suddenly developed to such extent, yet I had no prior suspicion of its presence...”

“From my experience I am satisfied there is much decay that is overlooked, and I believe if the truth were known, there are instances in which the best, most reliable and vigilant dental operators fail to discover decay until it is much advanced.”

Dr. James S. Knapp, in a paper presented at the American Dental Association annual session, 1868

Caries Identification Technology

Visual inspection

- Conclusion:
 - Visual examination alone is not a reliable technique for detecting early caries lesions

Caries Identification Technology

Radiographic examination

- Intraoral bitewing (BW) radiographs are the most widely used
 - Digital versus conventional: no diagnostic difference
- Easiest method to assess proximal surfaces
- ADA Radiographic Examination Guidelines (2012):

Dentists should not prescribe routine dental radiographs at preset intervals for all patients. A thorough clinical examination, consideration of the patient history, review of any prior radiographs, **caries risk assessment** and consideration of both the dental and the general health needs of the patient should precede radiographic examination.

ADA Radiographic Examination Guidelines

TYPE OF ENCOUNTER	PATIENT AGE AND DENTAL DEVELOPMENT STAGE				
	Child with Primary Dentition (prior to eruption of first permanent tooth)	Child with Transitional Dentition (after eruption of first permanent tooth)	Adolescent with Permanent Dentition (prior to eruption of third molars)	Adult, Dentate or Partially Edentulous	Adult, Edentulous
New patient* being evaluated for dental diseases and dental development	Individualized radiographic exam consisting of selected panoramic/occlusal views and/or posterior bitewings if proximal surfaces cannot be visualized or probed. Patients without evidence of disease and with open eruption contacts may not require a radiograph exam at this time.	Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images.	Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images. A full mouth intraoral radiographic exam is preferred when the patient has clinical evidence of generalized dental disease or a history of extensive dental treatment.	Individualized radiographic exam based on clinical signs and symptoms.	
Use clinical judgement, not routine habits					
Recall patient** with clinical caries or at increased risk for caries**	Posterior bitewing exam at 0-12 month intervals. If proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 6-18 month intervals.	Posterior bitewing exam at 6-18 month intervals.	Not applicable	
Recall patient** with no clinical caries and not at increased risk for caries**	Posterior bitewing exam at 12-24 month intervals. If proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam 18-36 month intervals.	Posterior bitewing exam at 24-36 month intervals.	Not applicable	

Caries Identification Technology

■ Radiographic examination

□ Conclusion:

Radiographic examination does significantly improve the reliability of visual examination for detecting early caries lesions

Rock WP & Kidd E. Dental radiographs and dental caries. Br Dent J164(8),1988

Neither technique alone is reliable for detecting early caries lesions

NIH consensus statement, March 2001: Current diagnostic practices (visual exam with an explorer and radiographs) are inadequate to achieve the next level of caries management in which noncavitated lesions are identified early so that they can be managed by nonsurgical methods.

Diagnosis and management of dental caries throughout life. NIH Consensus Statement, 18(1), March 2001

Caries Identification Technology

■ Radiography with computer-aided detection

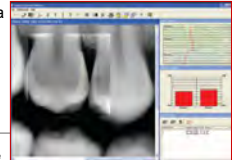
□ Detection may be completely computer-generated or in combination with practitioner input

■ Computer software contains data on patterns of caries lesions for comparison

□ An area of a tooth is selected

□ The computer generates a tooth density chart and a probability scale (0 to 1.0) whether the area is sound, decalcified, or carious

■ Practitioner can adjust the level of specificity (false positives)



Logicon Caries Detector Software

Caries Identification Technology

■ Radiography with computer-aided detection

□ Conclusion:

Evidence does indicate an increased ability for practitioners to accurately distinguish between caries lesions and healthy tooth structure with this software

The computer software essentially serves as a reliable second opinion

Caries Identification Technology

■ Caries-indicating dyes

□ Penetrate partially demineralized dentin due to the increased porosity

□ Dye stains are not specific for bacteria, but rather stain all demineralized dentin

□ However, the goal of caries removal in dentin is to remove only the soft bacterial "infected" dentin, leaving non-infected, hard dentin behind

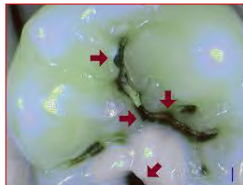
□ Therefore, there is risk of over-removal of tooth structure, i.e. diagnostic false positives, with dyes.

Caries Identification Technology

■ Caries-indicating dyes

□ Conclusion:

Dyes should not be used as the sole determining factor in clinical caries removal



They are best used as an adjunct in identifying the possible extent of caries progression during caries removal.

Caries Identification Technology

■ Visible light

□ Fiber optic transillumination (FOTI)

■ Reflecting light through teeth looking for optical transmission differences

■ More focused and higher intensity light increases the potential for detecting smaller, earlier caries lesions


■ May also identify fractures



MicroLux LED Trans-Illuminator System

Caries Identification Technology

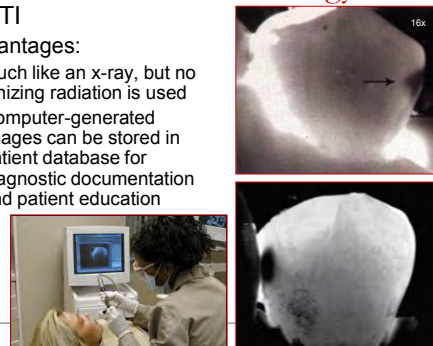
- Visible light
 - Digital imaging fiber optic transillumination (DIFOTI)
 - Same as FOTI, but an image is captured by a camera or computer
 - Image is similar to an x-ray



DIFOTI[®] transilluminates #20 on the facial (labial) side of the pre-molar and images the angular side.

Caries Identification Technology

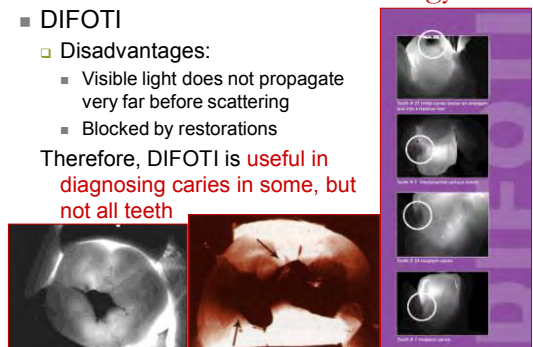
- DIFOTI
 - Advantages:
 - Much like an x-ray, but no ionizing radiation is used
 - Computer-generated images can be stored in patient database for diagnostic documentation and patient education



Caries Identification Technology

- DIFOTI
 - Disadvantages:
 - Visible light does not propagate very far before scattering
 - Blocked by restorations

Therefore, DIFOTI is **useful in diagnosing caries in some, but not all teeth**




Caries Identification Technology

- Visible light – FOTI and DIFOTI
 - Conclusion:
 - Fiber optic transillumination, both conventional and digital, should not be used as the sole determining factor in clinical caries detection
 - A good adjunct to a careful visual examination with radiographs

Caries Identification Technology


- Light-induced fluorescence
 - Measures refractive differences between healthy and demineralized enamel
 - Areas of caries and demineralization show less fluorescence
 - A fluorescent dye can be added to enable detection of dentin lesions
 - Coupled to a computer
 - AKA Quantitative Light-induced Fluorescence (QLF)



Inspektor Research System BV

Caries Identification Technology

- Quantitative, light-induced fluorescence (QLF)
 - Spectra Caries Detection Aid
 - Soprolife caries detection & intraoral camera



Caries Identification Technology

- Quantitative, light-induced fluorescence (QLF)
 - Changes can be tracked over time via digital measurements and images
 - Good evidence for accurate caries detection
 - Demonstrated consistency among users
 - Low false positives or negatives
 - Probably one of the most researched systems

Caries Identification Technology

- Quantitative light-induced fluorescence (QLF)
 - Conclusion:
 - QLF, while it appears to be the most accurate method currently available for detecting early caries lesions, **should still be considered as a good adjunct to a careful visual and radiographic examination**

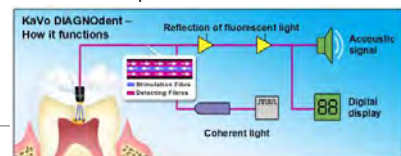
Caries Identification Technology

- Laser fluorescence
 - Uses visible light in the red spectrum (655 nm wavelength)
 - Reads reflected light
 - Sound tooth structure produces low intrinsic fluorescence
 - Demineralized tooth structure increases the amount of fluorescence reflected back to the receiver



Caries Identification

- Laser fluorescence
 - Demineralized tooth structure increases the amount of fluorescence reflected back to the receiver
 - The higher the reading, the greater the probability that caries is present

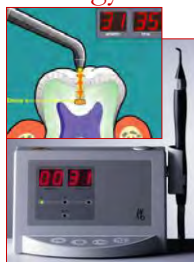


Caries Identification Technology

- Readings (suggested interpretation):
 - 0 – 15: no treatment needed
 - 16 – 30: preventive/restorative care depending on caries risk & recall interval
 - 31 – 99: restorative care advised

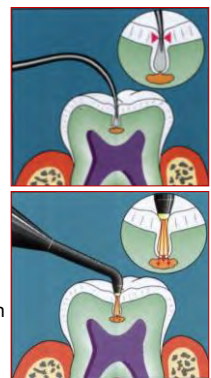
The higher the reading, the greater the probability that caries is present

High ability to detect caries



Caries Identification

- Laser fluorescence
 - Limitations:
 - Most useful for detecting occlusal caries
 - Limited to unrestored areas
 - Detects presence of caries, but not the full extent or true severity of a lesion
 - It provides an indirect measure of bacterial byproducts rather than identifying demineralized tooth structure
 - Increased false positives with stained fissures, plaque and calculus, prophyl paste, sealants and restorations



Caries Identification Technology

- Laser fluorescence
 - Conclusion:
 - Laser fluorescence should not be used as the sole determining factor in clinical caries detection
 - A good adjunct to a careful visual exam
 - It is best used as an adjunct in identifying the possible presence of occlusal caries

Caries Identification Technology

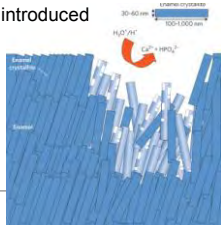
- Laser-induced infrared photothermal radiometry & modulated luminescence
 - Measures temperature change induced by infrared laser light ($\leq 1^\circ \text{C}$)
 - Highly accurate measurement of tissue densities
 - Evidence indicates that it has better sensitivity for caries detection than visual, radiographic, or laser fluorescence technologies



Canary System

Caries Identification Technology

- Electrical conductance
 - Saliva soaks into the pores of demineralized enamel and increases the electrical conductivity of that region versus that of sound enamel
 - Various systems have been introduced since the 1980's
 - Mixed success: promising, but inconsistent diagnostic predictability
 - Primarily for occlusal lesions



Caries Identification Technology

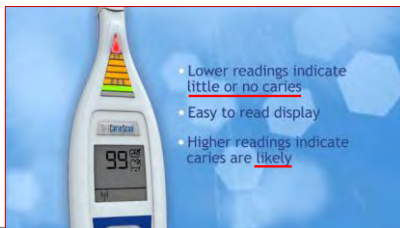
- Alternating current impedance spectroscopy
 - Advanced the electrical conductance theories by using multiple electrical frequencies to detect **occlusal and smooth surface caries**
 - More accurate and more reliable than ECM
 - Stains and discoloration do not appear to interfere



CariesScan PRO

Caries Identification Technology

- Alternating current impedance spectroscopy
 - Indicates tooth structure is healthy, in early stages of decay, or already significantly decayed



Caries Identification Technology

- Alternating current impedance spectroscopy
 - Conclusion:
 - AC impedance spectroscopy should not be used as the sole determining factor in clinical caries detection
 - A good adjunct to a careful visual exam
 - It is best used as an adjunct in identifying the possible presence of caries lesions

CAUTION: Impedance devices cannot be used on patients with cardiac pacemakers

Caries Identification Technology

Emerging Technologies

Ultrasound caries detector

- Uses high-frequency sound waves from handpiece
- Receiver-computer generates an onscreen acoustic reflection of the tooth
- Purported high sensitivity (caries present) and specificity (caries absent)



Caries Identification Technology

Emerging Technologies

Optical coherence tomography (OCT) using near infrared (NIR) transillumination

- Creates cross-sectional images of hard and soft tissue structures without ionizing radiation
 - Analogous to ultrasound imaging but uses light instead of sound
- Has the potential to “see through” the entire tooth
- An “optical biopsy” of any region of a tooth



Caries Identification Technology

Emerging Technologies

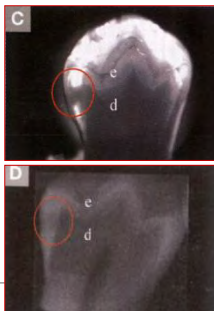
Optical coherence tomography (OCT)

Near Infrared (NIR) light transillumination
(via fiber optic handpiece)

versus

D-speed x-ray film

Note: Current use in ophthalmology and cardiac imaging



Caries Identification Technology

Emerging Technologies

Salivary diagnostics

- Saliva could be used to detect bacteria, enzymes, immunoglobulins, proteins, or breakdown products as a mirror not only of dental disease, but of other diseases within the body.
- Tests could be in-office or at-home.
 - Combinations of lab-on-a-chip & immunoassay technologies are currently being tested

Salivary diagnostics is an area of very active research throughout the health sciences

Caries Identification Technology

Emerging technologies

- Optical coherence tomography
- Ultrasound
 - Cross-sectional imaging permits the detection of the zones of caries lesions
- Salivary diagnostics
 - These technologies may allow us to discriminate between active, progressing lesions that should be treated and arrested lesions that may be left alone
- Summary:
 - Promising, but not yet available, caries detection technologies

Caries Identification Technology

- The current state of this technology is to allow us to make more accurate early lesion detection in conjunction with our traditional careful visual examination
- The objective is to detect lesions as early as possible.
 - Earlier detection opens the prospect of reversing decay and remineralizing tooth structure

Caries Diagnosis vs. Detection

- **Detection** identifies the signs and symptoms of caries disease
- **Diagnosis** is the art or act of identifying caries disease from its signs and symptoms
 - Diagnosis encompasses recognizing the presence of caries, its cause, and its prognosis
 - Why is the caries where it is?
 - What factor(s) are causing the caries?
 - What is the risk of the caries getting worse?
 - What can we do to arrest the existing caries and what can we do to prevent future caries?
- Preventive versus Reparative approach

Caries Management by Risk Assessment (CAMBRA)

- “In clinical care settings, diagnosis of caries implies not only determining whether caries is present (that is, detection), but also determining if the disease is arrested or active and, if active, progressing rapidly or slowly.”

Beauchamp et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants. Report of the American Dental Association Council on Scientific Affairs, JADA Vol. 139, March 2008

Detection of Caries = Nail in the Tire

Is there a cavity in the mouth?



Signs and Symptoms
-Nail in the tire
-Tire flat

Slide courtesy of Dr. Kim Kutsch

Caries Disease Severity =

How Many Nails in the Tire?



But why are we getting nails in the tire?

Slide courtesy of Dr. Kim Kutsch

Diagnosis of Caries Disease Risk =

How Many Nails are in the Driveway?

Disease is present even if there are no signs or symptoms



Is risk High, Medium, or Low?

Slide courtesy of Dr. Kim Kutsch

Caries Risk Assessment



Low Risk

High Risk

What are all of the factors affecting the risk level?

Slide courtesy of Dr. Kim Kutsch

Treatment: Repair versus Prevention



Does treatment of the signs and symptoms reduce the risk?
Does treatment of the signs and symptoms control the disease?

Slide courtesy of Dr. Kim Kutsch

Caries Management by Risk Assessment (CAMBRA)

- Ultimately, dental caries is a transmissible, bacterial infection
 - Simply removing a carious lesion does NOT remove the bacteria in the mouth that caused the lesion
 - However, removing and restoring carious lesions, in conjunction with anti-caries interventions, is an important first step in caries management.

Featherstone et al. Caries Management By Risk Assessment: A Clinical Trial 1999 – 2004, Caries Research, 2005

Caries Management by Risk Assessment (CAMBRA)

- Determining the caries risk of an individual is an important step in caries management equal to restoration of cavitated lesions
 - Risk assessment requires evaluating the number and severity of risk factors a patient has, and how those risks are counter-balanced by protective factors.
- Caries risk assessment is not a precise science, but it is a valuable tool that enables us to customize preventive strategies for each individual patient.

Featherstone JDB, Adair SM et al. Caries management by risk assessment: Consensus statement April 2002. J Calif Dent Assoc 31(3), 2003

Caries Management by Risk Assessment (CAMBRA)

- The object of CAMBRA is to treat the disease (caries), not just the symptoms (cavities)
- Caries risk assessment is used to drive clinical decisions
 - How aggressive should we be when deciding what to restore versus what to remineralize?
 - What restorative materials are best suited for long-term restorative success?
 - What chemical and/or behavioral interventions will best meet the patient's needs to reduce their caries risk?
 - What interventions is the patient motivated to use?

Caries Management by Risk Assessment (CAMBRA)

- The best risk indicators of caries disease are:
 - The number of existing caries lesions
 - The number of restored or missing teeth
- But what are the risk factors?

Zero D et al. Clinical applications and outcomes of using indicators of risk in caries management. J Dent Edu Vol 65 No. 10, 2001

Caries Management by Risk Assessment (CAMBRA)

Risk factors: anything that lowers the oral pH

- Poor oral hygiene
- Diet high in fermentable carbohydrates
- Low salivary flow
 - Due to habits, disease, or medications
- Or attracts plaque
- Exposed root surfaces
- Orthodontic or removable appliances

Busscher HJ & Evans LV. Oral Biofilms and Plaque Control. Gordon and Breach Publishing, Philadelphia, 1998

Caries Management by Risk Assessment (CAMBRA)

- Caries risk is a **balance** between caries-inducing and caries-preventing factors:

Inducers:

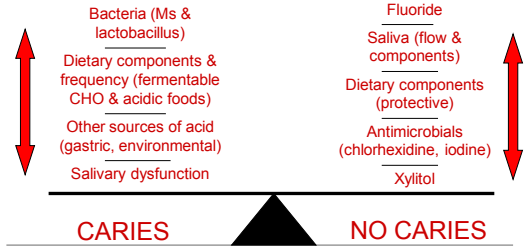
- Poor oral hygiene
- Multiple caries lesions
- Multiple restorations
- Low fluoride availability
- Low salivary flow
- Exposed root surfaces
- Ortho &/or removable appliances

Preventors:

- Good oral hygiene & dietary habits
- OTC fluoride toothpastes, rinses, and gels
- Rx fluoride toothpastes, rinses, and gels
- Rx antimicrobial rinses
- More frequent recall appts.

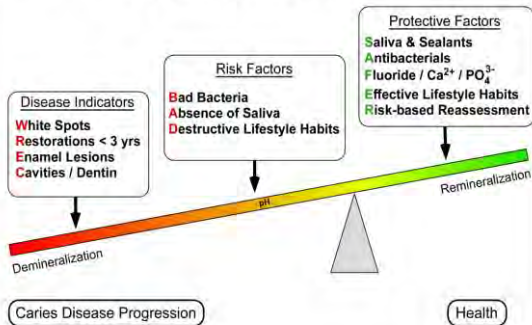
Caries Management by Risk Assessment (CAMBRA)

- The Caries Balance: which way will it tip?



Adapted from Dr. John Featherstone

The Caries Balance / Imbalance



Featherstone, Young & Wolf, 2007

CAMBRA Forms

Pacific CRA Form

- The best indicators of caries disease, and therefore high risk, are:
 - Number of existing caries lesions
 - Number of restored or missing teeth
 - This tells us what to expect without any intervention

Pacific CRA Form

- Risk factors predispose people to caries disease:
 - Acidogenic bacterial load and salivary competence can be measured
 - These measurements are analogous to measuring pocket depths, attachment loss, etc. to assess periodontal disease
 - These assessments should be done as early in the exam process as possible

Pacific CRA Form

Protective factors:

- We want to maximize these factors
- What behaviors or products can we recommend to our patients to increase these factors?

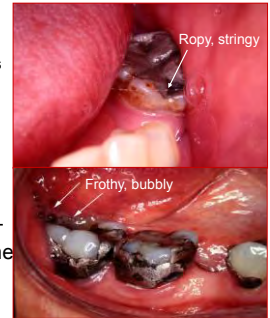
The image shows a 'Child Risk Assessment Form' for children aged 6 and over. It includes sections for 'Assessment Date', 'Assessment Site', and 'Assessment Type'. The 'Protective Factors' section is highlighted with a red box and contains a list of factors such as 'Brushing frequency', 'Flossing frequency', and 'Dietary habits'. Below this section is a 'Risk Factor' section with a balance scale icon.

Salivary Assessment

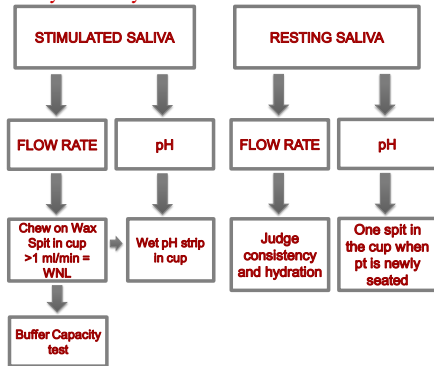
There four salivary assessments that can be performed

1. Resting flow rate
 - Low flow is seen with patients with thick, ropy/stringy saliva, or very frothy, bubbly saliva
2. Stimulated flow rate
3. Resting pH
4. Stimulated pH

These four salivary assessments are not routinely done on every patient



Salivary Analysis



Saliva: Resting Flow Rate

Ask questions:

- Does the patient feel that they tend to have a dry mouth all the time?
- Depends on the patient's level of activity and degree of hydration
- Dry, then apply tissue or gauze to the lips for 1 minute to measure resting flow of the minor salivary glands



Saliva: Stimulated Flow Rate

- If the resting flow rate is low, the stimulated should be checked as well
- Ask questions:
 - Does the patient feel that they tend to have a dry mouth when they eat?
 - Depends on the patient's degree of hydration
- To measure:
 - Patient chews paraffin pellet for 5 minutes
 - Spits all saliva into cup
 - Flow rate:
 - Normal = ≥ 1 ml/min.
 - Xerostomic = < 1 ml/min.



Measuring Salivary pH

- Resting pH
 - Have patient spit once into a cup before starting an oral exam
 - Dip pH paper into the saliva
- Stimulated pH
 - Dip pH paper into the cup if collected saliva for stimulated flow rate measurement
 - Or have patient spit once into a cup after completing the intraoral exam



Measuring Bacterial Load – Old Way

■ CRT (Caries Risk Test)

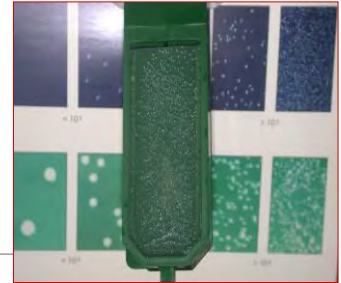
Vivadent, Ivoclar North America

- Take saliva collected from stimulated flow rate test
- Pour onto selective media culture slides
- Incubate for 48 – 72 hours



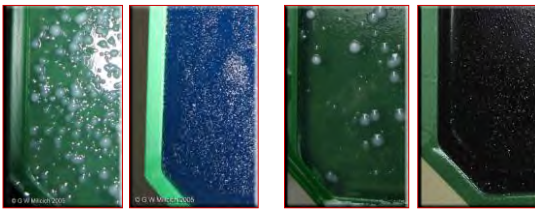
Measuring Bacterial Load – Old Way

- Compare the density of Colony Forming Units (CFUs) at caries recalls to the baseline density



Measuring Bacterial Load – Old Way

14 yr old with EXTREME Caries Risk



LB MS
Pre-treatment CRT test

3 months later: after initial course of antimicrobial rinses. Final quadrant yet to be restored.

Case courtesy of Dr. Graeme Millich

Measuring Bacterial Load – Old Way

14 yr old with EXTREME Caries Risk



But MS and LB are not the only caries causing bacteria present!

LB MS
Pre-treatment CRT test

5 months later - all cavities restored and a 2nd course of antimicrobial rinses

There is no quick fix!

Case courtesy of Dr. Graeme Millich

Measuring Bacterial Load – New Way

- As pH decreases in the biofilm, not only do the numbers of harmful bacteria increase, but **some healthy bacteria convert to harmful acid producing bacteria**
- Acid producing bacteria in the biofilm generate ATP
- The ATP meter measures the bioluminescence of the ATP
 - This is an indirect measure of the acidogenic bacterial load



Pellegrini P et al. Quantitative comparison of oral bacteria and detection with ATP-driven bioluminescence. Am J Orthod Dentofacial Orthop. 135(4). 2009

CariScreen by Oral BioTech

Measuring Bacterial Load – New Way

- CariScreen Caries Susceptibility Testing Meter and Swab
 - Correlates to caries risk level
 - >1500 = high load/risk
 - <1500 = low load/risk
 - Get results chair side in only 1 minute



Gallez F et al. Salivary biomass assessed by bioluminescence ATP assay related to cell counts. Cell Biochem Funct 18(2), 2000

Fazilat S et al. Application of Adenosine Triphosphate-driven bioluminescence for quantification of plaque bacteria and assessment of oral hygiene in children. Ped Dent Vol 32 No 3. May/June 2010

Oral BioTech

Measuring Bacterial Load

- Bacterial testing
 - Initial test provides a baseline reading of acid-producing bacterial load
 - Subsequent tests at caries recall appointments evaluate the success of intervention therapies
 - Behavior changes
 - Chemical recommendations and prescriptions
 - Or changes in the patients health or preventive capabilities

Pacific CRA Form

- Based upon all of the data we have gathered, a caries risk level is assigned:
 - Low
 - Moderate
 - High
 - Extreme (xerostomic)

The point of assigning a risk level is to help you decide how to treat the patient

INTERVENTION	CARIES RISK Level *** ###			
	LOW	MODERATE	HIGH*	EXTREME**
S SALIVARY	Recommended as per dentist assessment table 1. Risktests are always tailored for primary prevention.			
SALIVA	RESTING	① Detects resting flow rate using surrogate tests (saliva consistency or pH) or salivary gland expression (in 60 seconds)		
	STIMULATED	② Detects resting flow rate using surrogate tests (saliva consistency or pH) or salivary gland expression (in 60 seconds) ③ Measures pH using a cartridge test (stable in flow testing) rate response and for a 30 sec. flow reaction (pH) ④ Detects quantitative bacterial flow rate test. If assessment is supported, ⑤ Measure pH of the saliva collected.		
A ASSESSES BACTERIAL LOAD	Measures baseline vitroglycemic biofilm load via surface or ATP bioluminescence.			
A ANTI BACTERIAL THERAPY (Chlorhexidine or Chlorine based)	① High xerostomic, high, low or moderate pH neutralization as per manufacturer's instructions, which bacterial load up to 1 month. Dilute and suitable patient, and report as needed.			
F FLUORIDE	① High xerostomic, high, low or moderate pH neutralization as per manufacturer's instructions, which bacterial load up to 1 month. Dilute and suitable patient, and report as needed.			
F FACTORS FAVORABLE FOR REMINERALIZATION	① High xerostomic, high, low or moderate pH neutralization as per manufacturer's instructions, which bacterial load up to 1 month. Dilute and suitable patient, and report as needed.			
E EFFECTIVE DIET	① High xerostomic, high, low or moderate pH neutralization as per manufacturer's instructions, which bacterial load up to 1 month. Dilute and suitable patient, and report as needed.			
R RISK-BASED REASSESSMENT	① High xerostomic, high, low or moderate pH neutralization as per manufacturer's instructions, which bacterial load up to 1 month. Dilute and suitable patient, and report as needed.			

Caries Risk Management

- Brushing twice daily with a fluoride-containing dentifrice is one of the most effective ways to control dental decay
- High bacterial challenge/low oral pH overcomes the therapeutic effects of fluoride
 - Fluoride cannot remineralize tooth structure in a low pH environment

Caries Risk Management

- What interventions will best help the patient?
- And how can we best assess the outcomes of our attempts to treat caries disease?
- We need to establish some sort of baseline measure of the disease state to compare against:
 - The past: DMFT
 - The present (and the future): Salivary diagnostics
 - Saliva flow rate and buffering capability
 - Bacterial counts of acid producing species

Caries Risk Management

- CAMBRA Products
- a. Chlorhexidine rinse – antibacterial
 - b. CariFree Treatment Rinse – antibacterial, pH neutralizer
 - c. CariFree Maintenance Rinse – pH neutralizer, xerostomia
 - d. Fluoride rinse (ACT) - remineralization
 - e. CariFree Boost Spray – pH neutralizer, xerostomia
 - f. Baking soda toothpaste &/or rinse – pH neutralizer, xerostomia
 - g. Xylitol mints (or gum) – xerostomia (salivary flow stimulant), antibacterial; pH neutralizer (CariFree gum)
 - h. Fluoride varnish, MI or MI Plus Paste – desensitizer, remineralization
 - i. 5,000 ppm Fluoride toothpaste – remineralization

Treatment Rinse (CariFree CTx4)

- Mix equal amounts of A & B (~10 ml) and swish for 1 minute once or twice a day
- Has an extremely elevated pH of 10.0 - 11.0, which makes the biofilm environment inhospitable for acid-loving bacteria
- Active ingredient: Sodium hydroxide and sodium hypochlorite
- Other ingredients: Fluoride and 11% xylitol; alcohol free



Chlorhexidine Gluconate

- Rinse with ½ oz (15 ml) for 1 minute once or twice a day for one week
- Use a fluoride product for the next three weeks
 - Do NOT use fluoride and CHX together
- Repeat each month
- pH 5.0 – 7.0
- Active ingredient: 0.12% chlorhexidine gluconate; ~12% alcohol
- Brands: Peridex, PerioGard



How to Use Antimicrobial Rinses

- Continue to use until caries control is completed and bacterial counts are low
- Apply antimicrobials intensely, on a short term basis, to a therapeutic endpoint
- Set a "Caries Recall" dependent upon what you have prescribed and patient motivation
 - Usually want to do another ATP measure at 1 month
 - Repeat as frequently as you feel is appropriate

Summary of Antibacterial Rinses

- Treatment Rinse (CariFree CTx4)
 - Use once or twice a day until gone
- 0.12% Chlorhexidine (Peridex, PerioGard)
 - Use once or twice a day for 1 week per month
 - Does not work against lactobacillus
 - May cause staining, increased calculus formation
- Iodine (hospital dentistry)
 - Requires long contact time
- None of them taste very good
 - How you educate each patient on the importance of their use is crucial

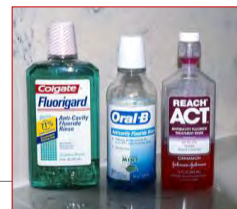
Maintenance Rinse (CariFree CTx3)

- Daily use to prevent the dental caries infection from returning
- Rinse with 10 ml for 1 minute
 - Usually use twice a day
 - For xerostomia: use more frequently, especially after snacking
- pH 8.0
- Active ingredient: 0.05% NaF
- Other ingredients: 25% xylitol (3 grams/dose); alcohol free



OTC Fluoride Rinses

- 0.05% NaF rinses are very effective in high caries risk patients when used once or twice daily for one minute, in combination with a fluoride-containing dentifrice
- Rinse with ½ oz. for 1 minute 1x or 2x daily (more often if xerostomic)



O'Reilly and Featherstone, Demineralization and remineralization around orthodontic appliances: an in vivo study. Am J Orthod Dentofacial Orthop 92(1), July 1987

High Fluoride Toothpaste

- 1.1% Na Fluoride = 5000 ppm
- Pea-sized amount twice a day
- Not for young children



High Fluoride Toothpaste

- High fluoride concentration (5,000 ppm F) toothpaste is more effective than regular F toothpaste (1,100 ppm) in high risk individuals
 - Especially effective against root caries

Baysan A et al. Reversal of primary root caries using dentifrices containing 5,000 and 1,100 ppm fluoride. Caries Res 35(1), 2001

- However, caries progression still occurred in many subjects even with high concentration fluoride use



MI Paste



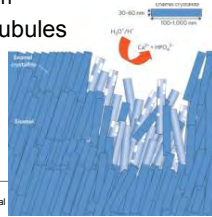
- Extra Calcium and Phosphate
- Helps remineralization, root sensitivity, and pH neutralization
 - Xerostomia/Salivary Gland Hypofunction (SGH)
- Rub on with a clean finger several times a day and/or use a “bleaching tray” overnight
- MI Paste Plus = with fluoride

Prospec™ MI Paste by GC America

- What it is:
 - MI = Mineral Imbalance
 - Water-based, sugar-free paste
 - Contains RECALDENT™ (CPP-ACP)
 - CPP = Casein Phosphopeptide
 - Binds to enamel, biofilm, and soft tissues
 - ACP = Amorphous Calcium Phosphate
 - Calcium & phosphate ions in non-crystalline state
 - Note: MI Paste does NOT contain fluoride; MI Paste Plus does contain fluoride

MI Paste Plus

- What it does:
 - CPP provides stable delivery vehicle for ACP free calcium & phosphate ions
 - Diffuse back into subsurface demineralized enamel for remineralization
 - Occludes open dentinal tubules
 - Reduces adherence of certain plaque bacteria
 - Mimics salivary buffering of healthy saliva



Robertson et al. MI paste plus to prevent demineralization in orthodontic patients: A prospective randomized controlled trial. Am Orthod Dentofacial Orthop 140(5), 2011

MI Paste Plus

- Uses:
 - Decrease tooth sensitivity
 - Prevention and remineralization of early caries lesions
 - Buffering of saliva in high caries risk patients
 - Should NOT be used on patients with milk protein allergies
 - Do course of MI Paste Plus before
 - Fluoride varnish application
 - Glass ionomer restorations

MI Paste Plus

- Decrease tooth sensitivity:
 - For exposed root surfaces
 - Due to whitening procedures
 - Patients with erosive diseases
 - GERD
 - Bulimia
 - Pregnancy
 - Apply with cotton swab or finger tip
 - Leave for 3 minutes, don't rinse; may be swallowed or expectorated
 - Repeat 2x/day

MI Paste Plus

- Prevention and remineralization of early caries lesions:
 - White spot lesions and fluorosis
 - Around appliances throughout orthodontic treatment and after debanding
 - Newly erupted teeth during post-eruption maturation phase
 - Apply nightly after brushing with fluoride toothpaste
 - Leave on overnight
 - Apply in morning after brushing if more severe case

Robertson et al. MI paste plus to prevent demineralization in orthodontic patients: A prospective randomized controlled trial. *Am Orthod Dentofacial Orthop* 140(5), 2011

MI Paste

- Buffering of saliva in high caries risk patients:
 - Resting saliva pH vs. stimulated flow
 - Xerostomia due to medications, chemo- or radiation therapy
 - Apply 2x/day after brushing
 - Combine with dietary modifications, fluoride toothpastes, chlorhexidine rinses, glass ionomer restorations

Fluoride Varnish



- Usually white or clear
- 5% Na Fluoride = 22,600 ppm
- Slowly releases fluoride for months
- Safe for infants and children
- Should be considered after cleanings



Fluoride Varnish and Gels

- Office-applied fluoride varnish and FI gel ($\geq 5,000$ ppm FI) do not require continuing patient compliance
 - Forms slowly soluble calcium fluoride-like deposits in lesions and the plaque
 - Gives slow release fluoride for several weeks
 - Recommend 3 – 4 applications a year for high risk patients



Lam A et al. Caries management with fluoride varnish of children in U.S. *NY State Dent J* 77(4), 2011
Donly KJ. Fluoride varnishes: A review. *J Calif Dent Assoc* 31(3), 2003

Fluoride Varnish and Gels

- Evidence-based clinical recommendations for professionally applied topical fluoride:
 1. Fluoride gel applied for 4 minutes or more is effective
 2. Fluoride varnish applied every 6 months is effective
 3. Two or more applications of fluoride varnish per year are effective in high caries risk individuals
 4. Office topical applications provide no added benefit for low risk individuals

The Council on Scientific Affairs, American Dental Association, May 2006

Acidulated Fluoride Gels

- 1.23% Acidulated Fluoride gels:
 - Fluorident, Protect, Gel-Cam
 - 4 minutes in-office via tray application
 - At-home patient use NOT RECOMMENDED



Case courtesy of Dr. Doug Young

Xylitol Gum or Mints

- A naturally occurring sugar
 - Slowly absorbed so lower caloric intake than other sugars
 - Does not require insulin for metabolism
 - Maintains neutral oral pH
 - Decreases adhesion of bacteria to teeth
 - Bacteria cannot metabolize it
- Therefore, it is strongly anti-acidogenic bacteria & decay

Xylitol Gum or Mints



- Gum
 - Each piece is 1 gram of xylitol
 - Need 5-10 grams per day
 - 5 – 10 pieces each day is ideal
- Mints
 - Each piece is 0.5 grams of xylitol
 - 10 – 20 pieces each day is ideal

Boost Spray (CariFree CTx2)

- Recommended for xerostomic patients
 - Calcium hydroxide with pH 9.0
 - Also contains 35% xylitol, and glycerine
 - Use 2 - 3 sprays as often as needed
 - Raises pH and prevents demineralization
 - Convenient size to fit in pocket



Products For Xerostomia



And sip water frequently; can mix 1 teaspoon of baking soda in 8 oz. of water as a simple pH neutralizer

Caries Management by Risk Assessment (CAMBRA)

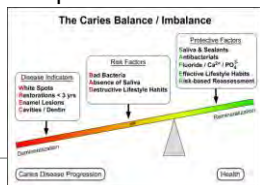
- Use chemical and behavioral therapies based upon clinical observations and evidence
 - ✓ What interventions will best meet the patient's needs?
 - ✓ What interventions is the patient motivated to use?
 - Start with one recommendation and check at recall (1 month?)
 - Add other recommendations as patient compliance/motivation warrants
 - Reassess and alter as needed over time

Caries Management by Risk Assessment (CAMBRA)

- Targeted antibacterial and fluoride therapy based on salivary microbial and fluoride levels favorably altered the balance between pathological and protective caries risk factors

Featherstone JDB, et al. A randomized clinical trial of anticaries therapies targeted according to risk assessment (CAMBRA). *Caries Research* 46(2), March 2012

Featherstone JDB & Doméjean S. The role of remineralizing and anticaries agents in caries management. *Adv. Dent. Res.* 24, 2012



Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - Office-based interventions for **low risk**
 - 6 month (+) recall exam and prophylaxis
 - Reinforce individualized OHI
 - BW radiographs every 12 to 18 months
 - Home-based interventions for **low risk**
 - Brush with OTC fluoride dentifrice 2x daily
- Complete a new caries risk assessment yearly

Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - Office-based interventions for **moderate risk**
 - 3 to 6 month recall exam and prophylaxis
 - Apply fluoride gel or varnish at every recall visit
 - Review dietary habits and oral hygiene instruction
 - Restorative treatment (MID) as needed
 - BW radiographs every 12 months
 - Home-based interventions for **moderate risk**
 - Brush with OTC fluoride dentifrice 2 x daily
 - Rinse with OTC fluoride rinse (0.05% NaF) twice daily
 - Xylitol gum or candies 4 x daily

Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - Office-based interventions for **high risk**
 - 3 month recall exam and prophylaxis
 - Caries bacteria test at least every 6 months (MS and LB)
 - Apply fluoride gel or varnish at every recall visit (3 – 4x per year)
 - Individualized OHI with possible specialized aids
 - Dietary counseling: limit between meal snacks, limit sodas
 - Sealants for posterior teeth with deep pits/fissures
 - Restorative treatment (MID) as needed
 - BW radiographs every 6 to 12 months

Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - Home-based interventions for **high risk**
 - Brush with 5000 ppm F prescription toothpaste
 - Chlorhexidine rinse (0.12%) 1x daily for one week every month
 - Fluoride rinse (0.05% sodium fluoride) 1 – 2x daily for remaining three weeks every month
 - Xylitol gum or candies 4x daily
 - Use sugar substitutes, e.g. xylitol or sorbitol
 - High and moderate caries risk patients should be re-evaluated and re-tested at each recall appointment.
 - The success of all applied interventions needs to be reassessed at each recall appointment.

Caries Management by Risk Assessment (CAMBRA)

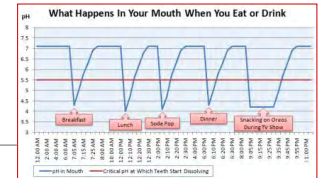
- Extreme Caries Risk Individuals (High Risk plus severe hyposalivation – Measured saliva flow rate less than 0.5 ml/minute)
 - Same as for high risk individuals PLUS:
 - Medical consult on medications or disease or medical treatment status
 - Baking soda rinse 4+x daily (2 teaspoons in 8 ounces water)
 - Consider fluoride trays for home use (1.1% neutral NaF gel) daily
 - Consider calcium phosphate home use gel (MI Paste)
 - 3 months caries recall: reapply F varnish and repeat risk assessment and bacteria test

Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - **Interventions for low salivary flow patients**
 - Avoid acidulated fluoride products
 - Educate patient about the caries process and the role of saliva in prevention
 - Recommend xylitol gum or mints to stimulate saliva flow
 - Recommend frequent sips of water
 - Rinse frequently with baking soda suspension in water (2 teaspoons in 8 oz. water)
 - Baking soda dentifrice will neutralize oral acids
 - ACT fluoride rinse daily (has no alcohol)

Caries Management by Risk Assessment (CAMBRA)

- Suggested risk-based interventions for adults
 - **Careful dietary counseling for all patients**
 - Discuss acidic versus basic foods and beverages
 - Discuss exposure times
 - Discuss preventive strategies



Caries Management by Risk Assessment (CAMBRA)

- Diet Counseling: preventive strategies
 - Assess the patient's dietary habits
 - Analyze eating and sugar exposure patterns and types of foods
 - Dietary diaries
 - Recall interviews
 - Reduce the frequency of sugars/carbohydrates
 - Suggest healthy alternatives

Dietary Counseling

The plaque pH after 30 minutes was higher in the cheese group than that of the milk and yogurt groups, both of which showed a pH toward baseline (neutral pH) after 30 minutes. These results suggest that cheese has the highest anticariogenic property among the dairy products studied, and that milk and yogurt can be considered as noncariogenic.



Teligi RL, et al. In vivo dental plaque pH after consumption of dairy products. Gen Dent 61(3), May - June 2013

Caries Management by Risk Assessment (CAMBRA)

- Caries risk assessment is a valuable tool that enables us to better tailor preventive strategies for each individual patient.
 - **Simply stated, each patient's preventive program must be custom fit to his or her individual risk areas or needs, just like all other dental treatment.**

Shugars D, Bader J. Risk-based management of dental caries in adults. Quality Resource Guide, Metropolitan Life Insurance Co, Oct 2003

Caries Management by Risk Assessment (CAMBRA)

- The object of CAMBRA is to treat the disease, not just the symptoms
- **We strive to detect caries lesions early enough to reverse or prevent progression**
 - Use high fluoride-releasing agents to
 - Remineralize non-cavitated lesions
 - Prevent progression of incipient lesions or development of new lesions
 - Arrest existing frank decay

Management of Caries Lesions

- However, symptoms such as cavitated lesions do need to be treated
- **Use minimally invasive restorative techniques to conserve as much tooth structure as possible**
 - Requires a thorough knowledge of new dental materials and their proper use

Management of Caries Lesions

- Caries is site specific and every caries lesion should not be treated alike
 - Cluster analysis yielded evidence of 5 distinct groups of tooth surfaces that differ with respect to caries:
 - C1: pit and fissure molar surfaces
 - C2: mandibular anterior surfaces
 - C3: posterior non-pit and fissure surfaces
 - C4: maxillary anterior surfaces
 - C5: mid-dentition surfaces

Shaffer JR, et al. Clustering tooth surfaces into biologically informative caries outcomes. J Dent Res 92(1), Jan 2013

Occlusal Caries = Pit and Fissure Caries

- 44% of caries lesions in primary teeth are found in the pits and fissures of molars
- 90% of caries lesions in permanent posterior teeth are found in the pits and fissures

Beauchamp et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants. Report of the American Dental Association Council on Scientific Affairs. JADA Vol. 139, March 2008

Pit and Fissure Caries

The hardest to detect visually or radiographically

- Hard to clean
- Hard to monitor remineralization
- Requires most aggressive treatment for prevention
- Use caries biopsy?
- Use sealant?



Steinberg S. A modern paradigm for caries management. Part 1: Diagnosis and treatment. Dentistry Today, Feb 2007

Classification of Caries Lesions

- Useful when assessing severity of a lesion
- International Caries Detection and Assessment System (ICDAS) for occlusal caries

ICDAS code	0	1	2	3	4	5	6	
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.	Localized enamel breakdowns, with no visible dentin or underlying shadow.	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 dentin cavity with dentin; cavity in deep and wide involving more than half of the tooth surface.	Extensive distinct cavity with dentin; frank cavitation involving less than half of a tooth surface.

- Classification is particularly useful for initial charting of lesions
- Describes a well defined, standardized baseline status

ICDAS code	0	1	2	3	4	5	6	
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.	Localized enamel breakdowns, 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 dentin cavity with dentin; cavity in deep and wide involving more than half of the tooth surface.	Extensive distinct cavity with dentin; frank cavitation involving less than half of a tooth surface.
Histologic Depth		Lesion depth in PIF was 90% in the outer enamel with only 10% into dentin.	Lesion depth in PIF was 50% inner enamel and 50% into the outer I/G dentin.	Lesion depth in PIF with 70% in dentin.	Lesion depth in PIF with 85% into dentin.	Lesion depth in PIF with 100% in dentin.	Lesion depth in PIF 100% reaching inner I/G dentin.	
Sealant/restoration Recommendation for Low Risk	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Minimally Invasive restoration	Minimally Invasive restoration	Minimally Invasive restoration	
Sealant/restoration Recommendation for Moderate Risk	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Minimally Invasive restoration	Minimally Invasive restoration	Minimally Invasive restoration	
Sealant/restoration Recommendation for High Risk	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Minimally Invasive restoration	Minimally Invasive restoration	Minimally Invasive restoration	
Sealant/restoration Recommendation for Extreme Risk	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Sealant or Minimally Invasive restoration needed	Minimally Invasive restoration	Minimally Invasive restoration	Minimally Invasive restoration	

* Patients with egg (or rice) cavitated lesions† and 1-1/2-1/2 patients. ** Patients with egg (or rice) cavitated lesions† and 1/2-1/2 patients are extreme risk patients.
 † All sealants and restorations in the dent with a minimally invasive philosophy in mind. Sealants are defined as confined to enamel. Restoration is defined as in dentin. A new surface restoration is defined as a preparation that has one part of the preparation in dentin and the preparation extends to a second surface (note: the second surface does not have to be in dentin). A sealant can be either tooth-bonded or glass ionomer. Resin-based sealants should have the most conservatively prepared fissure for proper bonding. Glass ionomer should be considered when the enamel is immature, or where fissure preparation is not desired, or where rubber dam isolation is not possible. Patients should be given a choice in material selection.

ICDAS code	0	1	2	3	4	5	6
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 "bluish" 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.	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 surface.
Histologic Depth		Lesion depth in PPF was 90% in the outer enamel with only 10%.	Lesion depth in PPF was 50% inner enamel and 50% into the outer 1/3.	Lesion depth in PPF with 77% in dentin.	Lesion depth in PPF with 85% in dentin.	Lesion depth in PPF with 100% in dentin.	Lesion depth in PPF 100% reaching inner 1/3 dentin
Sealant/restoration Recommendation for Low Risk	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration
Sealant/restoration Recommendation for Moderate Risk	Sealant or restoration	Sealant Recommended DIAGNOdent may be helpful	Sealant Recommended or Caries Biopsy if DIAGNOdent is 20-30	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration
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 or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration
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	Sealant or restoration	Sealant or restoration	Sealant or restoration	Sealant or restoration

* Patients with any (or all) of the following conditions are at high risk for caries: All sealants and restorations in dentition are defined as permanent restorations. Sealants are defined as restorations that are not permanent. Sealants can be either resin-based or glass ionomer. Resin-based sealants should have the most conservative prepared fissures for proper bonding. Glass ionomer should be considered where the stained or eroded or where fissure preparation is not desired, or where rubber dam isolation is not possible. Patients should be given a choice in material selection.

Jenson et al., Clinical protocols for caries management by risk assessment, J Calif Dent Assoc 35(10), Oct 2007

Pit and Fissure Sealants:

- Eliminate the bacterial niches, potentially preventing occlusal caries
- If incipient caries lesions already exist, do sealants stop the decay?
- Or do they only slow the development of decay?

Sealants can prevent the progression of early noncavitated carious lesions

Beauchamp et al., Evidence-based clinical recommendations for the use of pit-and-fissure sealants, Report of the American Dental Association Council on Scientific Affairs, J Am Dent Assoc 139(3), March 2008

Pit and Fissure Sealants:

- Placement of resin-based sealants on the permanent molars of children and adolescents is effective for caries reduction
 - At 1 year = 86% reduction
 - At 2 years = 78.6% reduction
 - At 4 years = 58.6% reduction
 - If **reapplied** as needed, at 4 years = 76.3% reduction
 - 65% reduction at 9 years with no reapplication during last 5 years

Beauchamp et al., Evidence-based clinical recommendations for the use of pit-and-fissure sealants, Report of the American Dental Association Council on Scientific Affairs, JADA Vol. 139, March 2008

Pit and Fissure Sealants:

- Sealants can prevent the progression of early noncavitated carious lesions
 - Placement significantly reduces the percentage of such lesions that progress in children, adolescents and young adults for as long as 5 years after placement
 - Bacteria do not increase under sealants
 - Sealants over existing caries lower viable bacterial count by at least 100-fold
 - Reduce number of lesions with any viable bacteria by 50%

Beauchamp et al., Evidence-based clinical recommendations for the use of pit-and-fissure sealants, Report of the American Dental Association Council on Scientific Affairs, JADA Vol. 139, March 2008

Pit and Fissure Sealants:

- Should be placed on pits and fissures of teeth of patients of any age when it is determined that the patient is at risk of developing caries
- Sealants prevent caries disease ...provided they remain sealed!
 - Data from Clinical Research Associates: **92% of sealants removed after 10 years of intraoral service had carious lesions underneath**

Beauchamp et al., Evidence-based clinical recommendations for the use of pit-and-fissure sealants, Report of the American Dental Association Council on Scientific Affairs, JADA Vol. 139, March 2008

Pit and Fissure Sealants

- Fissure widening versus no prep
 - "Caries biopsy" recommended for ICDAS Class 3
 - Determine full extent of caries
 - Remove demineralized enamel
 - Better fill of material into fissure
 - Fissure bur versus air abrasion
 - Evidence inconclusive; both work
 - Acid etching recommended after either



Pit and Fissure Sealants

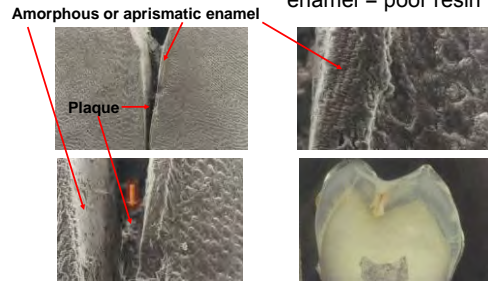
Resin versus glass ionomer sealants

- Filled resins
 - Most wear resistance
 - Potentially best retention
 - Significantly improved retention with use of rubber dam
- Unfilled resins
 - Retention similar, but less wear resistance
- Glass ionomer
 - Less wear resistance
 - Lower retention rate

Beauchamp et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants. Report of the American Dental Association Council on Scientific Affairs. JADA Vol. 139, March 2008

Sealants

- Resin versus glass ionomer: debris and aprismatic enamel = poor resin bond



The micromechanical bond of resin is best if prisms are at right angles

The chemical bond of GI bonds equally well to aprismatic enamel

Sealants

Resin versus glass ionomer

- Glass ionomer
 - Better retention with difficult isolation
 - Better retention with partially erupted teeth
 - Better retention with immature enamel formation
- But are retention and wear resistance really the essential merit of a sealant?
- What about prevention?

Castro A & Feigel RF. Microleakage of a new improved glass ionomer restorative material in primary and permanent teeth. *Pediatr Dent* 24(1), 2002

Croll TP & Nicholson JW. Glass ionomer cements in pediatric dentistry: Review of the literature. *Pediatr Dent* 24(5), 2002



Sealants

Resin versus glass ionomer

- Glass ionomer
- What about prevention?
 - Has continuous fluoride release via recharging
 - Reduced caries incidence around GI sealants
 - Use as a "temporary" restorative material and surface protectant where you want to deliver long term fluoride release



8 year old GI sealant



12 year old GI sealant

Mikhaeilich S et al. Absence of carious lesions at margins of glass-ionomer and amalgam restorations: A meta-analysis. *Eur J Paediatr Dent* 10(1), 2009
Budzisz AW & Subar P. Community-based prevention and early intervention strategies. *J Calif Dent Assoc* 40(7), July 2012

The Approximal Lesion

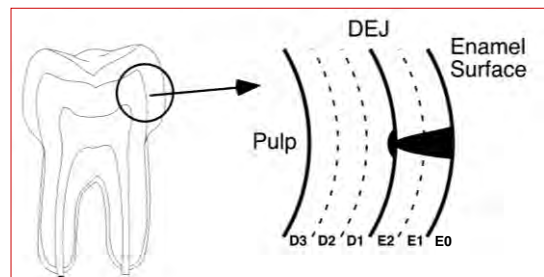
= White Spot Lesion

The best for remineralization...as long as it is not cavitated



Steinberg S. A modern paradigm for caries management. Part 1: Diagnosis and treatment. *Dentistry Today*, Feb 2007

Classification of Approximal Lesions



Management of Approximal Lesions

How likely is it that an approximal lesion has a cavitated surface?

- E1: 0% if in the outer 1/2 of enamel or E1
- E2: 10.8% if in the inner 1/2 of enamel or E2
- D1: ?
- D2: 40.9% if in the outer 1/2 of dentin or midway point of D2
- D3: 100% if in the inner half of the dentin or beyond the midway point of D2

Pitts & Rimmer used a classification system of E1, E2, D1, D2 only:

- Pitts & Rimmer D1
- Pitts & Rimmer D2

Pitts NB & Rimmer PA, An in vivo comparison of radiographic and directly assessed clinical caries status of posterior approximal surfaces in primary and permanent teeth. Caries Research, 1992

Management of Approximal Lesions

Approximal Site	Radiographic E0 (Simulated Radiographic Image**** (applies to all approximal surfaces))	Radiographic E1 (Outer 1/2 enamel)	Radiographic E2 (Inner 1/2 enamel)	Radiographic D1 (outer 1/3 dentin)	Radiographic D2 (middle 1/3 dentin)	Radiographic D3 (inner 1/3 dentin)
	Remineralize			?	Restore	
	Chance of cavitation ≤11%				Chance of cavitation ≥41%	

Can you tell clinically if the surface is cavitated?

Management of Approximal Lesions

- Restoration of Class II lesions
 - Resin versus resin modified glass ionomer (RMGI)
 - Resin is superior with proper isolation and technique
 - Glass ionomer may be used as a liner to enhance adhesion and seal of an overlying resin restoration
 - Consider a sandwich technique for subgingival preparations
 - Glass ionomer may be used in small one and two surface preparations

Yip KH et al. The effects of two cavity preparation methods on the longevity of glass ionomer cement restorations: An evaluation after 12 months. J Am Dent Assoc Vol. 133, 2002
Chadwick BL & Evans DJ. Restoration of class II cavities in primary molar teeth with conventional and resin modified glass ionomer cements: A systematic review of the literature. Eur Arch Paediatr Dent 8(1), 2007

Management of Root Caries Lesions

The hardest to restore

- Increased incidence in the elderly
- Difficult to restore with contemporary materials
 - Glass ionomer
 - Best retention to dentin
 - Best retention for difficult gingival isolation situations
 - Esthetically inferior to resins
 - Resin modified GI vs. regular GI

Demineralization → Remineralization

Dull + rough = active decay Smooth + shiny = inactive decay

Management of Root Caries Lesions

Glass Ionomers

A good option for root caries in non-esthetic zones

Management of Root Caries

- An Exposed Root is a Root at Risk
- Prevention of root caries is the best course
 - Fluoride inhibits demineralization and enhances remineralization
 - Fluoride varnishes
 - Fluoride rinses and/or high fluoride toothpaste
 - MI paste plus
 - Buffer pH in xerostomic/SGH patients
 - Baking soda rinses
 - Xylitol gum or mints
 - Connective tissue grafting to cover the exposed root surface

Management of Caries Lesions

- Use minimally invasive restorative techniques to conserve as much tooth structure as possible
 - Bonded materials maintain tooth strength



Novy BB & Fuller CE. *The material science of minimally invasive esthetic restorations*. Compendium 29(6), 2008

Management of Caries Lesions

- Use minimally invasive restorative techniques to conserve as much tooth structure as possible
 - Is it necessary to remove all carious tooth structure?
 - Numerous studies indicate that there are **significant advantages to incomplete caries removal**, especially in the treatment of deep caries
 - **If the restoration can be completely sealed**
 - Conservative approaches followed by bonded restorations diminished bacterial loads and did not have higher restoration failure rates
 - Showed significant risk reductions for pulpal exposure and post-operative pulpal symptoms
 - A sealed restoration should arrest caries progression, but evidence is currently inconclusive

Schwendicke F et al. *Incomplete caries removal: A systematic review and meta-analysis*. J Dent Res 92(4), 2013

Management of Caries Lesions

- Enamel tooth structure
 - Enamel is porous
 - By volume: 85% carbonated apatite, 3% lipids & proteins, 12% water
 - Bacteria are too large to fit through the enamel pores of an intact surface, but organic stains can enter
 - Acids, however, can enter the pores and cause demineralization of enamel
 - Demineralization = **affected** enamel
 - If left untreated, demineralization leads to cavitation
 - Bacteria can enter cavitations, causing bacterial **infection** of the enamel
 - There is always a layer of **demineralized affected** enamel separating healthy enamel from **infected enamel**

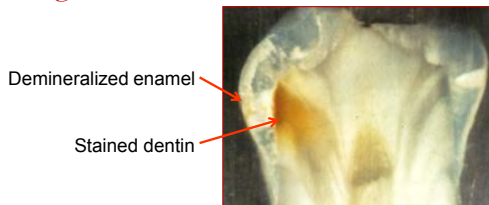
Young DA et al. *Current Concepts in Cariology*. Dental Clinics of North America 54(3), July 2010

Management of Caries Lesions

- Dentin tooth structure
 - Dentin is very porous
 - Acids penetrating through the enamel cause demineralization of the underlying dentin
 - Dentin demineralizes much more rapidly than enamel
 - Demineralized dentin = **affected dentin**
 - **Affected dentin** is typically stained, but relatively hard
 - As cavitation progresses from the enamel into the dentin, bacteria begin to invade the dentin
 - **Infected dentin** is soft and mushy
 - Bacteria survive via their link with nutrients in the saliva penetrating through the cavitated enamel and passing into the dentin tubules

Young DA et al. *Current Concepts in Cariology*. Dental Clinics of North America 54(3), July 2010

Management of Caries Lesions



- Stained, affected dentin is not infected if the overlying enamel is intact
 - This lesion can be remineralized, and the enamel will be more caries resistant than the original surface

Management of Caries Lesions

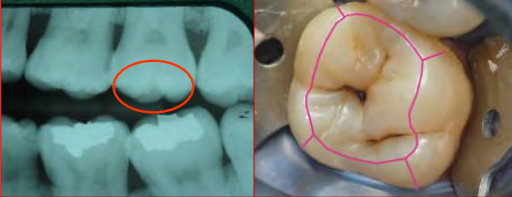
- Use minimally invasive restorative techniques to conserve as much tooth structure as possible
 - Partial versus Complete caries removal
 - Ideal treatment is to remove all soft, mushy **infected dentin** while leaving any hard stained **affected dentin**
 - However, if complete removal of infected dentin poses a risk of unnecessary pulpal involvement, infected dentin may be left
 - Cariogenic bacteria, once isolated from their nutrient source, either die or remain dormant
 - It is essential that the lesion is well-sealed off from the oral environment
 - Removal of demineralized tooth structure from the margins is required
 - Glass ionomer restorative materials maximize adhesion

Thompson V et al. *Treatment of deep carious lesions by complete excavation or partial removal: A critical review*. J Am Dent Assoc 139(6), 2008

Management of Caries Lesions

#15: Pre-op bitewing shows no occlusal caries lesion

#15: Pre-op appearance (ICDAS 3)



We will try to preserve the marginal ridges as much as possible

Management of Caries Lesions

Most infected dentin has been removed, but some remains in the central pit

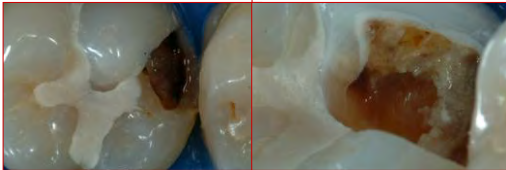
A glass ionomer liner was placed over the central pit prior to resin restoration



Management of Caries Lesions

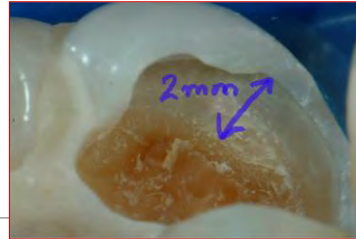
The initial lesion appearance

Caries removal in progress

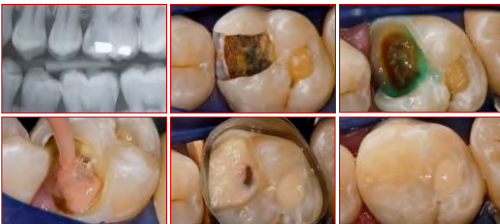


Management of Caries Lesions

- Caries removal is stopped to avoid the pulp
- Infected dentin remains, but we have clean, hard margins established all the way around the prep



Management of Caries Lesions



A Glass ionomer liner is placed under the resin restoration

Case courtesy of Dr. Hien Ngo

Management of Caries Lesions

- Partial versus Complete caries removal
 - These techniques were originally developed for use in less-developed parts of the world where traditional access to dental care is difficult
 - Atraumatic Restorative Technique (ART)
 - Interim Therapeutic Restorations (ITR)
 - These techniques are increasingly becoming part of the minimally invasive philosophy in developed countries
 - Becoming part of contemporary dental practice in the U.S.
- Provide long term resistance to continued or recurrent caries disease destruction of tooth structure

Tyas MJ et al. *Minimal intervention dentistry – A review*. FDI commissioned project 1-97. Int Dent J 50, 2000
Budeniz AW & Subar P. *Community-based prevention and early intervention strategies*. J Calif Dent Assoc 40(7), July 2012

Management of Caries Lesions

- Partial versus Complete caries removal
 - ART/ITR restorative techniques
 - Ideal treatment is to remove all soft, mushy infected dentin while leaving any hard stained affected dentin
 - However, if complete removal of infected dentin is not necessary, particularly if this poses a risk of unnecessary pulpal involvement
 - It is essential that the lesion is well-sealed off from the oral environment
 - Removal of demineralized tooth structure from the margins is required
 - Conventional GI materials may be used as a liner beneath a resin restoration
 - Resin modified GI materials may be used for the entire restoration

Yip HK et al. Selection of restorative materials for the atraumatic restorative treatment (ART) approach: A review. Spec Care Dent 21(6), 2001
Budzisz AW & Subbar P. Community-based prevention and early intervention strategies. J Calif Dent Assoc 40(7), July 2012

Management of Caries Lesions

- One final item of technology for treating caries:
 - **Ozone treatment (O₃):** a very potent oxidizer
 - Ozone gas may be used as a preparation cleanser
 - Exposure to ozone gas rapidly disinfects carious dentin and stops the decay process in previously infected tooth structure



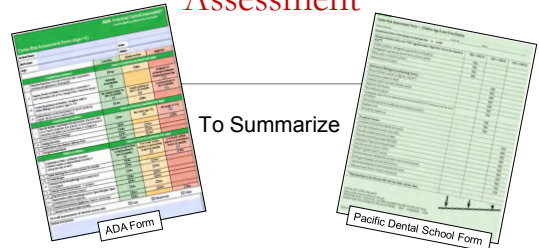
Saini R. Ozone therapy in dentistry: A strategic review. J Nat Sci Biol Med 2(2), 2011

Management of Caries Lesions

- **Treatment with ozone gas**
 - 20 – 40 sec. exposure eliminates live bacteria, viruses, and fungi
 - Primes previously infected dentin for remineralization



Caries Management by Risk Assessment



To Summarize

Caries Management by Risk Assessment (CAMBRA)

- The object of CAMBRA is to treat the disease, not just the symptoms
- ✓ Use chemical and behavioral therapies based upon clinical observations and evidence
 - ✓ What interventions will best meet the patient's needs?
 - Reassess and alter as needed over time: **Caries recalls**
 - ✓ What interventions is the patient motivated to use?
 - Reassess and alter as needed over time: **Caries recalls**

Caries Management by Risk Assessment (CAMBRA)

- The object of CAMBRA is to treat the disease, not just the symptoms
- ✓ Detect carious lesions early enough to reverse or prevent progression
 - ✓ High fluoride-releasing agents to remineralize non-cavitated lesions
 - ✓ High fluoride-releasing agents to prevent progression of incipient lesions or development of new lesions
 - ✓ High fluoride-releasing agents to arrest and better manage existing decay

Caries Management by Risk Assessment (CAMBRA)

- The object of CAMBRA is to treat the disease, not just the symptoms
- ✓ Use minimally invasive restorative techniques to conserve as much tooth structure as possible
 - ✓ Requires thorough knowledge of new dental materials and their proper use
 - ✓ This is a challenge, but isn't that exciting?
 - ✓ Use an evidence-based approach to assess materials and techniques

Caries Management by Risk Assessment (CAMBRA)

- Like most infectious diseases, dental caries can manifest bursts of activity with periods of quiescence
- Caries disease is a chronic infection; its prevention requires constant vigilance
 - Schedule aggressive caries recall appointments
 - Have risk factors shifted?
 - What is the caries balance now?

Shugars D, Bader J. Risk-based management of dental caries in adults. Quality Resource Guide, Metropolitan Life Insurance Co, Oct 2003

Caries Management by Risk Assessment (CAMBRA)

- The success of CAMBRA implementation lies
 - In educating our patients of the value of this service to their oral and overall health
 - In the dedication of the entire dental office team to teaching and providing this service
- CAMBRA encompasses treatment of the entire patient
 - By earlier, potentially more conservative treatments
 - By lifelong preventive measures

Caries Management by Risk Assessment (CAMBRA)

- Patient Education
 - When patients understand the risk factors and possible outcomes, they are empowered to take control of their dental needs and future
- As a result, patients are more accepting of your preventive and treatment recommendations as presented
 - Patients place a greater value on the service available from your whole dental team

Caries Management by Risk Assessment (CAMBRA)

- Get the whole dental team involved by delegating duties
 - **Dental hygienists**
 - Periodontal risk assessment
 - **Dental assistants**
 - Caries risk assessment and photographs
 - **Both DHs and DAs**
 - OHI and caries intervention protocol education
 - **Office manager and front office personnel**
 - Reinforce need for regular check-ups/monitoring
 - Answer patient questions, assist with computer-based patient learning system programs

Caries Management by Risk Assessment (CAMBRA)

- Patient Education by the Dental Team
 - It is in everyone's best interests to improve each patient's knowledge of oral health in general, and of their own oral health or disease state in particular.
- Advantages
 - Creates rapport and trust that your office wishes to serve the patient's needs = patient trust
 - Creates value in the patient's mind for the services they need = greater treatment acceptance
 - Patient's can make an informed decision about their health care = informed consent

Caries Management by Risk Assessment (CAMBRA)

- Patients need to understand
 - They have a risk of disease
 - Their risk of disease can change over time
 - There are steps they can take to reduce and/or minimize their risk over time
 - You and your office team are there to help them
- The goal is to help the patient realize their role in controlling treatment outcomes, and the need for regular check-ups/monitoring
 - **Empower your patients**

Caries Management by Risk Assessment (CAMBRA)

- Many patients want to improve the appearance of their teeth
 - Bleaching
 - Orthodontics
 - Crowns and veneers
 - Bridges and implants
- But they are reluctant to do so because they keep getting new "cavities"

Help them control their dental diseases and they will seek these additional services FROM YOU

Caries Management by Risk Assessment (CAMBRA)

- For many patients dentistry is a discretionary expense
 - They will not invest in something they do not understand
 - They will not invest in something they believe will fail
- Treatment plan presentation
 - How can you increase treatment plan acceptance?
 - In a word...EDUCATION
 - The more a patient knows and understands about their oral health/disease, **and the more they can do to control their oral health**, the more value your treatment plan will have to them

Caries Management by Risk Assessment (CAMBRA)

- By taking the time to educate your patients, you will
 - Increase their satisfaction in your practice
 - Increase their acceptance of needed care
 - Increase their desire for optional care
 - Increase their referrals to your practice
 - Increase your satisfaction with your practice
 - You are providing your patients with the best care
 - Your practice will be more productive than ever

It's a win – win situation!

Caries Management by Risk Assessment (CAMBRA)

Can you afford the time?

How can you afford NOT to take the time?

It's a win – win situation!

Caries Management by Risk Assessment (CAMBRA)

- Resources
 - February and March 2003 Journals of the California DA
 - October and November 2007 Journals of the California DA
 - October and November 2011 Journals of the California DA
 - The CDA Foundation at www.cdafoundation.org/journal

