

# Unveiling the Mystery of Caries Management: What's the Secret?

## COURSE DESCRIPTION

The non-surgical intervention of incipient carious lesions has become the standard of care in modern dental therapy. Re-mineralization of these lesions is the most noninvasive of all dental procedures and can result in the maintenance of the integrity of the dentition. From risk assessment to implementing therapy, this course will provide the needed information to implement conservative caries management in the dental practice.

## COURSE OBJECTIVES

Upon completion of this course, participants will be able to:

1. Discuss the etiology and epidemiology of caries
2. Establish a risk management program for caries management in the dental practice which incorporates a team approach.
3. Define CAMBRA and utilize it to identify a patient's risk potential for developing carious lesions.
4. Design and implement an individualized re-mineralization plan for patient treatment.

### 1. Dental Caries Etiology and Process

- Bacterially-based, chronic, infectious, and communicable disease process
- Acquired most readily through "vertical transmission" from mother to child
  - Horizontal transmission from child to child and adult to adult transmission also possible

#### Treatment as an Infectious Disease

- Shift from "surgical" approach to "medical" approach
  - Surgical (restorative) approach focuses on restoring the symptoms of the disease (lesions)
  - Medical approach focuses on treating the etiological causes of the disease

#### Tooth Composition

- Enamel = 96% mineral / 4% lipid, protein, water
- Dentin & cementum = 47% mineral / 53% lipid, protein, water

#### Mineral Composition

- Carbonated hydroxyapatite **Ca<sub>5</sub>(PO<sub>4</sub>, CO<sub>3</sub>)<sub>3</sub>(OH)**
  - Calcium deficient
  - Carbonate-rich areas are more susceptible to acid attack

#### Deminceralization Process

- Plaque biofilm consists of acidogenic bacteria (S mutans, Lactobacilli) which metabolize fermentable
- carbohydrates to produce acids
- Acids diffuse into tooth thru diffusion channels following simple concentration gradient
- As acids diffuse, they dissociate into hydrogen ions
- Hydrogen ions dissolve the mineral crystal, freeing calcium and phosphate into solution

- Calcium and phosphate ions diffuse, following concentration gradient, from tooth to plaque/saliva


**2. The Caries Balance**

**Proposed by Dr. Featherstone in 1999**

- Recognizes the caries process as:
  - Multifactorial
  - Balance between PROTECTIVE factors and PATHOLOGICAL factors
    - Balance is delicate; swings either way several times daily
  - If PATHOLOGICAL factors outweigh PROTECTIVE factors
    - Risk is greater that caries will initiate/progress

**Key Protective Factors**

- Saliva components and flow
- Fluoride, calcium, phosphate
- Antibacterial agents

**Key Pathological Factors**

- Cariogenic bacteria
- Fermentable carbohydrates
- Salivary dysfunction

**Disease Indicators**

Indicative of past caries history & activity; past caries history is best predictor of future caries activity

- Visual white spots on smooth surface
- Any restorations placed in past 3 years
- Radiographic lesions confined to enamel only
- Frank cavitations that show penetration into dentin


**3. Risk Factor Management: Caries Management by Risk Assessment**

**Risk Based Approach**

- Categories:
  - Low
  - Moderate
  - High
  - Extreme High (high risk + hyposalivation)
- Treat patients by risk
- Identify patients with higher risk

- Treat higher risk patients more aggressively

**CAMBRA Principles**

- Identify cause of disease by assessing risk factors & disease indicators for each individual patient
- Correct the problems by managing/manipulating risk factors to alter the Caries Balance to favor health

**Risk Assessment Tools/Forms**

- American Dental Association-ADA
  - Caries Risk Assessment-CRA
- California Dental Association-CDA
  - Caries Risk Assessment-CRA
- American Academy of Pediatric Dentistry-AAPD
  - Caries Assessment Tool-CAT


**4. Clinical Examination and Assessment**

**Medical, Dental and Social History**

- Medical History - include recreational drug use
- CART – Classification and Regression Trees
- CAMBRA – Caries Management by Risk Assessment

**Clinical Examination and Diagnostic Values**

- Sensitivity (SE): the probability that a test will correctly identify disease/demineralization
- Specificity (SP): the probability that the test will correctly identify sound enamel/absence of disease
- Reliability (R): the dependability or consistency of a measurement method
- Low sensitivity can miss significant amounts of decay
- Low specificity produces numerous false positives

**Traditional Detection Techniques**

- Visual
- Tactile (explorer)
- Radiographic
- Low sensitivity; High specificity

**Visual**

- Color
- Translucency
- Texture

**ICDAS – International Caries Detection and Assessment System**

- Grades tooth health status numerically ranging from 0 – 6.
- Codes are part of diagnosis; no direct link between codes alone and treatment options.

- 0 Sound tooth surface. No evidence of caries after air drying for 5 sec. Surfaces with developmental defects such as enamel hypoplasia, fluorosis, tooth wear, extrinsic & intrinsic staining are recorded as sound.
- 1 First visual changes in enamel: caries opacity, white or brown lesion seen after air drying within pit and fissure areas, distinct white or brown change in enamel when wet and extending beyond fissure/fossa area. (Early stage decay)
- 2 Distinct visual change in the enamel. No visible dentin; widening of the fissure. Ball-end probe may be used to confirm the cavitation (Early stage decay)
- 3 Localized enamel breakdown, surface integrity loss (Established decay)
- 4 Underlying dentin shadow (Established decay)
- 5 Distinct cavity with visible dentin at base and walls (Severe decay)
- 6 Extension cavity within visible dentin

**Radiographic**

- Low sensitivity: 39% occlusal 50% interproximal
- 40-60% demineralization required to produce visible image
- insufficient to determine activity level
- Digital enhancements, such as contrast adjustment, may offer small gain in sensitivity

**Explorer (Tactile)**

- 62% sensitivity
- Eliminates potential for lesion reversal by disrupting the intact surface layer
- Recommended usage is to remove plaque and assess surface roughness by gently scraping shaft of explorer


**5. Adjunctive Detection Technologies**

**Beneficial because:**

- Changed behavior of carious lesions decreases the predictive value of traditional methods;
- Slow lesion progression allows opportunity to reverse the lesion if detected earlier

**Digital Fiber Optic Transillumination (DIFOTI)**

- Detects occlusal, interproximal, smooth surface and recurrent lesions
- 69% sensitivity for proximal lesions
- 80% sensitivity for occlusal lesions

**Quantitative Light Fluorescence (Inspektor)**

- Detects occlusal lesions only; no interproximal detection    61% sensitivity
- Can monitor progression
- Good research instrument; not practical for clinical use

**Laser fluorescence (Diagnodent)**

- Detects occlusal only up to 2 mm depth    80% sensitivity
- Dry field required
- Calibrates against healthy tooth in each patient
- Quantifies results from 0 -99

- Useful for confirming presence of occlusal caries that involve dentin

**AC Impedance Spectroscopy**

- Low voltage current
- Evaluates mineral density
- Assigned 0 – 100 with color
- No calibration; library of 2000 images
- Software necessary to display and tabulate

**Light Induced Fluorescence (SoproLife)**

- Fluorescence light-induced camera
- Illuminates tooth surfaces and facilitates high magnification image
- Detects and locates differences in density, structure and/or chemical composition
- Provides magnification of 50X of tooth surface
- Software required to view and store images

**Photo thermal Radiometry and Modulated Luminescence**

- Detects caries on all tooth surfaces under sealants & around margins of restorations
- Detects caries 50 microns up to 5 mm below the surface
- Not affected by stain or calculus
- Dry field not required
- Sensitivity of 92% compared to 67% for bitewing radiography

**Transillumination Technology**

- Patented transillumination technology
- No need to clean the tooth of bacteria
- No calibration needed
- Detects occlusal caries
- Interproximal caries
- Cracks
- Secondary/recurrent caries

**Fluorescence Aided Caries Excavation (FACE)**

- Aids in the detection and monitoring of carious tooth substance
  - Particularly dentin during excavation of previously opened cavities


**6. Bacterial Counts, Salivary and Dietary Assessments**

**Cariogenic Bacteria**

- Mutans streptococci (*S mutans* & *S sobrinus*)
  - INITIATE enamel caries
- Lactobacilli colonize dentinal lesions
- Levels > 105CFU/ml of either MS or LB indicate a high risk for caries
- Baseline levels should be established for:
  - High risk patients
  - Mothers

- New patients
- Change in levels is monitored after interventive/preventive therapy
- Caries susceptibility testing– bacterial assessment
  - Caries risk test: CRT® Ivoclar Vivadent
  - ATP test: CariFree®

**Saliva**

- Flushes carbohydrates
- Buffers acids
- Provides proteins & lipids
  - Protective pellicle
  - Supersaturation of Ca & PO
  - Antibacterial
- Fluoride carrier

**Palliative Treatment**

- Buffering products
- Artificial salivas
- Xerostomia products

**Fermentable carbohydrates**

- Demineralization potential:
  - Frequency of exposure
  - Retentive nature
  - Point of consumption
- Soft Drink Consumption:
  - pH of soft drinks = 2-4
  - Critical pH for enamel dissolution = 5.5
  - High in sugar content
  - “Sip All Day, Get Decay®”

**Salivary Dysfunction**

- Flow Rates
  - >1 ml/min = Normal
  - 0.7 ml/min = Low
  - <0.5 ml/min = Dry
- Low or dry flow rate places patient at “Extreme high risk”


<b>7. Recommended Therapies</b>
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**Alkaline Product:**

- Oral sprays, gel, gum, snacks, and drinks
- pH range 8-11
- Reverse bacterial shift
- Prevention 8-9; Treatment 9-11

## Fluoride

- Inhibits bacterial metabolism
- Inhibits demineralization
- Enhances remineralization

## Fluoride Sources

- The new recommendation:
  - Single level of 0.7 milligrams of fluoride per liter of water
  - This updates and replaces the previous recommended range issued in 1962
- Systemic:
  - 1000-2000 ppm in outer enamel;
  - 20-100 ppm in subsurface during tooth development
- Topical: can deliver as much as
  - 30,000 ppm to the surfaces of the individual crystals
- Optimal salivary concentration
  - 0.1 ppm high risk patients
  - 0.02 – 0.04 ppm for low risk

## Fluoride Dentifrices

- 1000 – 1300 ppm
- ~ 35% reduction in caries
  - Sodium fluoride
    - 0.24% NaF
  - Stannous fluoride
    - 0.4% SnF<sub>2</sub>
  - Sodium monofluorophosphate
    - 0.76% Na<sub>3</sub>PO<sub>3</sub>F
- Rx dentifrice
  - 1.1% NaF
  - 5000 ppm
  - High risk patients
    - 2x/day Expectorate; no rinsing

## Fluoride Rinses & Gels

- 0.05% NaF rinse (OTC)
  - 224 ppm
  - Mod risk pt
    - 10 ml / 30 secs / 3x day
  - High risk pt
    - 10 ml/ 30-60 secs/ 2 x day
- 0.2% NaF rinse (Rx)
  - 900 ppm
  - High risk pt
    - 10 ml / 30-60 secs/ daily
- 0.4% SnF gel
  - 1000 ppm
    - Brush on gels have compliance issues
- 1.1% NaF gel
  - 5000 ppm

## Professional Fluoride Options

- 1.23% APF
  - 12,300 ppm
  - Low ph 3.0 enhances uptake

- Contraindicated for composite or porcelain restorations
- 2% NaF
  - 9000 ppm
  - Neutral pH 7.0 safe for esthetic restorations
- 5% NaF varnish
  - 22,600 ppm
  - Adheres to tooth to maximize contact
  - High concentration in small quantity of material
  - Safe for young children & special needs patients
- Application:
  - Dry field not required
  - Apply to all tooth surfaces
  - No brushing for min of 4 hours
  - 2-4x/yr application- depending on risk
  - High risk patient should receive applications through restorative treatment
  - Code D1206

#### **ADA Clinical Recommendations for Fluoride**

- Risk based
- Recommends gel or varnish
- 4 minute application
- NaF & APF equally effective

#### **Sugar Substitutes and Artificial Sweeteners**

- FDA approved
  - Aspartame
  - Aceulfame potassium
  - Saccharin
  - Sucralose
  - Neotame
- FDA GRAS
  - Sorbitol
  - Xylitol
  - Erythritol
  - Tagatose
  - Stevia

#### **Xylitol**

- Natural sweetener found in a wide range of everyday products
  - sugar-free gum, toothpaste, gels, lozenges, etc
- Limited evidence that xylitol is effective in preventing dental caries in children/adults.

#### **Calcium Phosphate Technologies**

- Increase amount of Ca & PO<sub>4</sub> available to tooth surface
  - To increase concentration gradient and promote remineralization
- ADA Foundation ACP
- CPP-ACP
- NovaMin<sup>®</sup>
- Tri-Calcium Phosphate

#### **ADA Foundation ACP**

- Amorphous calcium phosphate
- Requires 2 phase delivery system
- Highly soluble / low substantivity

#### **CPP-ACP: Recaldent™**



- Uses milk protein casein phosphopeptide as a carrier for ACP
- Release Ca & PO during acid challenge

#### **NovaMin®**

- Hypersensitivity Product
  - In toothpaste in many countries outside USA
- Uses bioactive silica as carrier for Ca & PO<sub>4</sub>
- Release Ca & PO<sub>4</sub> immediately upon interaction with saliva
- Forms an enamel-like mineral layer

#### **Tri-Calcium Phosphate**

- Combines beta tri-calcium phosphate and sodium lauryl sulfate
  - forms a more functionalized calcium phosphate
- TCP provides a slow release of calcium onto tooth surface as it contacts saliva

#### **Antibacterial Therapy**

- Indicated for high risk patients with a high challenge of MS or LB

#### **Sodium Hypochlorite**

- 0.2 % is antibacterial
- FDA considers oral rinse solutions with less than 0.3% concentration safe for daily use
- Bactericidal to all bacteria on contact
- Possible to eliminate/reduce the cariogenic microbes
- Limitations include alteration to taste
- Recommended 6 yrs and older

#### **Chlorhexidine 0.12%**

- ADA Council of Scientific Affairs (2011) stated that:
- Beyond CHX-thymol varnish every 3 months for root surface lesions, all other CHX products in any form, for any lesion site, for any age, is not recommended

#### **Povidone Iodine 10%**

- Reduces MS & LB in children
- Professional application only
- Swish 10 ml for 1 min
- Or swab 1-2 ml for 2 min

#### **Sodium Hypochlorite**

- 0.2 % is antibacterial
- FDA considers oral rinse solutions with less than 0.3% concentration safe for daily use
- Bactericidal to all bacteria on contact
- Possible to eliminate/reduce the cariogenic microbes
- Limitations include alteration to taste
- Recommended 6 yrs and older

#### **CariFree® System**

- Dental products to balance pH
- Xylitol (sugar substitute)
- Rinse, spray, gum, wipes, lollipops

#### **Nanoparticles of Hydroxyapatite**

- Supersaturation of Hydroxyapatite and Fluorapatite in saliva
- Thermodynamically stable form of calcium phosphate
- 20 nm size (850<sup>th</sup> width of human hair)
- Mimic building blocks of natural enamel and effective as enamel repair
- Anticaries agent


<b>8. Pit and Fissure Sealants</b>
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**Sealants**

- Remains most effective means for arresting or reversing early occlusal lesions

**Sealing Incipient Lesions**

- Inhibits lesion progression
- May promote regression
- Decreases bacterial colonization
- Supported by ADA & AAPD

**Sealant effectiveness is technique-sensitive and dependent upon:**

- Technique
  - Adequate etching of surface
  - Maintaining dry field
  - Complete coverage of surface
- Site Selection
  - Individual risk
  - Tooth risk
- Monitoring/re-application

**Sealant Technology**

- Resin-based
- Glass-ionomer
- Self-cure vs. light cure
- Filled or unfilled
- Fluoride releasing

**Silver Diamine**

- Provides immediate relief from dentinal hypersensitivity
- Kills pathogenic organisms
- Hardens softened dentin making it more acid and abrasion resistant
- Does not stain sound dentin or enamel
- Gives important clinical feedback
  - Due to its potential to stain visible or hidden lesions

**ADA Recommendations for Sealant Usage**

- Reduces bacteria
- Resin-based are more effective
- Mechanical preparation is not recommended
- Use of self-etch bonding agents is not recommended
- Total etch bonding systems improve retention
- Four-handed application technique

**Caries Infiltration**

- Treatment for incipient lesions

- Micro-invasive for interproximal ( $\leq$  D1), smooth surface lesions
- Reduces lesion progression
- Masks white spot lesions in 1 appt

**Probiotics**

- Contains bacterial species
- GRAS for human consumption
- No two probiotics are alike; therefore, should not expect reproducible results
- pH should be corrected or healthy bacterial are unable to survive

**Bleaching and Caries Control Research**

- 10% carbamide peroxide
- Custom-fitted tray worn nightly
- Use in combination with chlorhexidine

**Atraumatic Restorative Treatment**

- Minimally invasive approach for prevention and caries management
- Complementary component for at-risk teeth and restoring carious lesions


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