"TREATING CARIES CHEMICALLY USING GLASS IONOMER AND REMINERALIZATION"

Course Description:
Dental caries in an infectious disease affecting children and adults throughout life. This course will address current trends in caries disease management, including caries risk assessment, new detection technologies and the use of glass ionomer to manage this disease. With current scientific evidence and new technologies, the clinician will be able to redirect management from a pure restorative (surgical) approach to a medical (preventive/therapeutic) approach.

Course Objectives:
Upon completion of the course the participant will be able to:
1. Recognize trends in caries disease management.
2. Indentify disease indicators and the pathogenic and protective factors (caries risk assessment) for an individual.
3. Compare and contrast caries detection techniques, including visual, tactile, radiographic, fiber optic transillumination, laser fluorescence, and red-infrared reflectance.
4. Differentiate the modes of action of various agents used to arrest or reverse demineralization process including fluoride, xylitol, antibacterials, sealants (resin and glass ionomer), pH neutralizing agents, calcium and phosphate enhancers, and others.
5. Implement a caries management by risk assessment approach into clinical practice.
6. Recognize the important role of pH and saliva on the disease process.

Outline:
Bacterially-based, chronic, infectious, and communicable disease process
- Acquired most readily thru "vertical transmission" from caregiver to child and "horizontal transmission" from child to child or adult to adult

Treatment as an Infectious Disease
- Shift from "surgical" approach to "medical" approach
- Surgical (restorative) approach focuses on restoring the signs of the disease (carious lesions)
- Medical approach focuses on treating the ethological causes of the disease.

Caries Etiology
- Mutans streptococci (MS) and Lactobacillus (LB) are aciduric and acidogenic; pH 3.8-4.8
- But there are other low pH non-MS bacteria (Takahashi and Nyvad, Caries Res 2008) that contribute to the problem

Biofilm Update
It is the pH not the sugar that selects for a normal biofilm to change into a pathogenic, aciduric and acidogenic biofim (Bradshaw and Marsh, Caries Res 1998). Therefore many are now focusing on modifying the biofilm and chemistry by using pH modification products. Helpful information at www.carifree.com

Demineralization/Remineralization Process
Tooth Composition:
- Enamel = 85% mineral / 15% lipid, protein, and water
- Dentin & Cementum = 47% mineral / 53% lipid, protein , water

Mineral Composition

- Carbonated apatite $Ca_5(PO_4,CO_3)_3(OH)$
- Calcium deficient
- Carbonate – rich areas are more susceptible to acid attack
- If carbonate is removed and replaced by phosphate (via remin) surface is now acid resistant and better than before

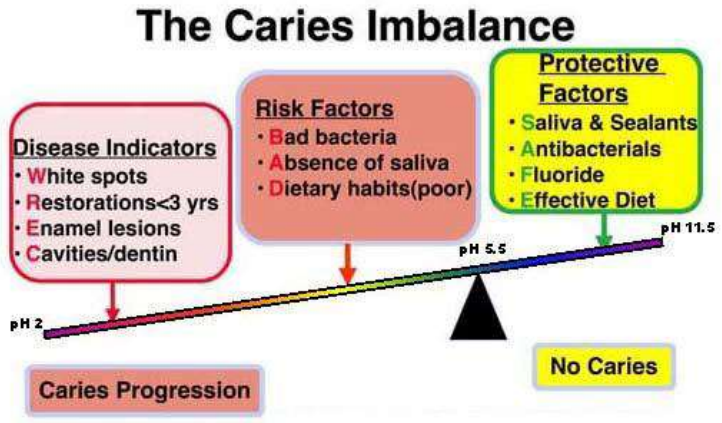
Demineralization Process

- Plaque biofilm consists of acidogenic and aciduric bacteria (S mutans, Lactobacilli, low pH non-MS) 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, form tooth to plaque/saliva

The Caries Balance

Proposed by Featherstone in 1999. Recognized the caries process as:

- Multifactoral
- Balance between PROTECTIVE factors and PATHOLOGICAL factors
- Balance is delicate and swings either way several times daily in most people
- If PATHOLOGICAL factors outweigh PROTECTIVE factors, the risk is greater that caries will initiate/progress



Disease Indicators

Indicative of past caries history and activity, past caries history is best predictor of future caries reactivity. If you have any of these you either have the disease now or have had it in the recent past. However disease indicators do not tell you what is out of balance or how to correct it.

- **W**hite spots on smooth surface
- **R**estorations placed in past 3 years
- **E**namel radiographic lesions
- **C**avitations into dentin

Risk Factors and Protective Factors (see caries imbalance figure above)

By measuring each risk and protective factor you are really doing a caries risk assessment. What is missing tells you exactly how the patient got out of balance and tells you exactly how to correct

it. It guides you in the chemical decision process. The trick is to get the patient the correct intervention/products and getting cooperation to modify their behavior.

Caries Management by Risk Assessment (CAMBRA)

Risk Based Approach

- Treat patients by risk rather than all the same (one size fits all)
- Identify patients with higher risk
- Treat higher risk patients more aggressively

CAMBRA Principles

(see Oct and Nov 2007 CDA Journals at www.cdafoundation.org/journal)

- 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

- CDA www.cdafoundation.org/journal
- ADA www.ada.org/prof/resources/topics/caries.asp#additional
- AAPD CAT www.aapd.org
- Prenatal to Age 5 www.first5oralhealth.org

Caries Detection

Diagnostic Values

- Sensitivity (SE): the probability that a test will correctly identify disease
- Specificity (SP): the probability that the test will correctly identify health
- Reliability (R): the dependability or consistency of a measurement method

Low sensitivity can miss significant amounts of decay (false negatives)
Low specificity produces numerous false positives

Traditional Detection Techniques

- Visual
- Tactile (explorer "stick")
- Radiographic

Visual

- Color
- Translucency
- Texture

Explorer (Tactile)

- 15-40% sensitivity
- Could eliminate 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

Radiographic (Occlusal)

- 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

New Direction Technologies
Needed because the changes in behavior of carious lesions decreases the predictive value of traditional methods; slow lesion progression allows a wide window of opportunity to reverse the lesion if detected earlier.

- Digital Fiber Optic Transillumination
- Quantitative light fluorescence
- Infrared fluorescence
- Red – infrared reflectance
- ICDAS (International Detection and Assessment System)

Detection and treatment depends on:
- Site or location (occlusal, approximal or root)
- Extent or depth
- Activity

A better way for the Occlusal surface
ICDAS – International Caries Detection and Assessment System
(see Jenson article Oct 2007 CDA Journals at www.cdafoundation.org/journal)

- Grades tooth health status numerically ranging from 0-6.
- Codes are part of diagnosis; no direct link between codes alone and treatment options.
- Jenson article first to link protocol to codes, see Oct 2007 CDA Journals at www.cdafoundation.org/journal)

0. Sound tooth surface. No evidence of caries after air drying for 5 seconds. Surfaces with developmental defects such as enamel hypoplasia, flourosis, 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.
2. Distinct white or brown change in enamel when wet and extending beyond fissure/fossa area.
3. Localized surface enamel breakdown. No visible dentin; widening of the fissure. Ball-end probe may be used to confirm the surface enamel breakdown.
4. Underlying dark shadows from dentin, with or without cavitation.
5. Distinct cavity with exposed dentin at base
6. Extensive (gross) distinct cavity with visible dentin at base and walls

Digital Fiber Optic Transillumination (DIFOTI)
- Detects demineralization (not cavitation or bacteria) occlusal, interproximal, smooth surface and recurrent lesions
- 69% sensitivity for proximal lesions
- 80% sensitivity for occlusal lesions

Quantitative Light Fluorescence (Inspektor)
- Detects demineralization (not cavitation or bacteria) 61% sensitivity
- Can monitor progression
- Good research instrument; it's value for clinical use remains to be seen

Laser fluorescence (DiagnoDENT)
- Detects bacterial by-products on 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

- Useful clinically as an adjunct

***Red–Infrared Reflectance (Midwest Caries ID*)**

- Detects demineralization (not cavitation or bacteria) on occlusal and interproximal lesions up to 3mm depth
  - 80% sensitivity for interproximal
  - 92% sensitivity for occlusal
- Wet field usage
- Calibrates against established target
- Visible and audible signals
  - Green light = sound
  - Red light = demineralized
  - Intensity of audible beep varies with extent of demineralization
- It's value in clinical use remains to be seen

Risk Factor Management

Objective is to minimize the pathological factors and maximize the protective factors to favor prevention, reversal or arrestment of caries.

PATHOLOGICAL FACTOR

Cariogenic Bacteria

-Mutans streptococci *(S mutans & S sobrinus)*

-Lactobacilli colonize

-Levels $\geq 10^5$CFU/ml = a high risk

-Low pH non MS bacteria

Baseline levels should be established for

- High risk patients
- Mothers
- New Patients

Monitor change in levels

PROTECTIVE FACTOR

Antibacterial Therapy

-Indicated for high challenge of MS, LB, or low pH non MS bacteria

-0.12% Chlorhexidine

- Reduces MS; not effective against LB
- 10 ml 1 min Bedtime 1 week/month Follow with 3 weeks NaF rinse

- CariFree Treatment Rinse

- 10 ml 1 min Bedtime 2 weeks/month Follow with 2 weeks CariFree Maintenance Rinse

-10 % povidone iodine

- Reduces MS & LB in children in the OR only
- Professional application only
- Swish 10 ml for 1 min

-Xylitol

- Decreases levels of MS
- 1 gram xylitol / stick of gum
  - Adults 6 -10 sticks / day 5min/stick
  - Older children 4 -5 sticks/day 5mins/stick

PATHOLOGICAL FACTOR

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
- also high in sugar content

www.mndental.org
"Sip All Day, Get Decay®"

PATHOLOGICAL FACTOR

Salivary Dysfunction

- Stimulated Flow Rates
  - ≥ 1 ml/min = Normal
  - 0.7 ml/min = Low
  - ≤ 0.5 ml/min = Dry
- Low flow rate places patient at high risk

PROTECTIVE FACTOR

Saliva

- Flushes carbohydrates
- Buffers acids
- Provides proteins and lipids
- Protective pellicle
- Supersaturation of Ca & PO_4
- Antibacterial

Palliative Treatment

- Buffering products
- Artificial saliva
- Xerostomia products

Protective Factors:

Topical Fluoride

Enhances the natural remineralization process Fluoride

- Inhibits bacterial metabolism
- Inhibits demineraliazation
- Enhances remineralization

Antibacterial Agents

- 0.12% Chlorhexidine gluconate
  - Most studied for caries
  - Effective on MS but not LB, stains teeth, alters taste
  - Rinse 1 min BID or QD X one week repeat each month
  - May take several months to years
- 1% Iodine
  - Effective on children in the operating room (high contact time) but not so effective on adults with a one minute exposure time
  - Bad taste and looks
  - Office use only. Not for patients to do at home.
  - Check for iodine allergy
  - I am not recommending this
- Hypochlorite-based product (CariFree Treatment Rinse, Oral BioTech)
  - New, needs more research
  - Seems to work much quicker clinically on both MS, LB and low pH non MS bacterial
  - Balances pH as well
  - Rinse 1 min BID or QD for 2 weeks

Fluoride Sources

Systemic sources of F can impart at the most 1000 – 2000 ppm in outer surface; 20 – 100 ppm in subsurface during tooth development

Topical application can incorporate 30,000 ppm, there for is the major reason for caries reduction

Optimal salivary concentration = 0.1 ppm high risk patients

0.02 – 0.04 ppm for low risk

Fluoride Dentrifices

- 1000 – 1300 ppm
- ~ 35% reduction in caries
- Sodium fluoride 0.24% NaF

- Stannous fluoride 0.4% SnF_2
- Sodium monfluorophosphate 0.76% Na_2PO_3F

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 10ml / 30 – 60 secs/ daily
  - 900 ppm
  - High risk pt 10ml / 30 – 60 secs/ daily
- 0.4% SnF gel 1000 ppm Brush on gels have compliance issues
- 1.1% NaF gel 5000 ppm

Professional Fluoride Treatments

- 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 pt should receive applications thru restorative treatment
- Code D1206

ADA Clinical Recommendations for Fluoride

- Risk based
- Recommends gel or varnish
- 4 minute application
- NaF best (APF has lower levels of evidence)

Xylitol

Xylitol is a natural sugar (usually from Birch trees) that can not be utilized by acid producing bacteria and has unique anti-caries properties. It inhibits bacterial attachment of MS to the tooth surface and has been shown to disrupt the vertical transmission of pathogens from caregiver to child. Studies have demonstrated an effective dose of 6-10 grams of Xylitol per day to be effective. Xylitol is low caloric and diabetic safe for humans but not safe for pets such as dogs (it has been published in the veterinary literature that one piece of gum can kills dogs)

Calcium Phosphate Technologies

Increase the amount of Ca & PO available to surfaces to increase concentration gradient and promote remineralization

- ADA Foundation ACP
- CPP-ACP
- Novamin
- Sensistat

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

CSP (Novamin) Uses bioactive silica as carrier for Ca & PO

- Calcium Sodium Phosphosilicate
- Release Ca & PO immediately upon interaction with saliva
- Directly forms HCA – hydroxycarbonate apatite
- Continual release for up to 2 weeks post application

TCP (Tri Calcium Phosphate)

- Calcium oxides become 'protected' by the organic materials
- Stable with fluoride so products are using it to combine F and Ca delivery
- new

Combination Products

Recently new products have immerged to increase cooperation of patients and staff. By combining already proven technologies into fewer products it simplifies delivery and makes it simpler for offices to use. One example is Oral Biotech makers of the CariFree line. This company has pH control as a core value along with combining already existing technologies. Helpful information at www.carifree.com

Pit and Fissure Sealants

Remain 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 cleaning and chemical preparation of surface
  - Complete coverage of surface
- Site Selection
  - Individual risk
  - Tooth risk
- Monitoring/re-application

Sealant Technology

- Resin-based (Mechanical retention)
- Glass-ionomer (chemical seal, internal remineralization, and surface F recharging)
- Self-cure vs. light cure
- Filled vs. unfilled
- Fluoride vs. no fluoride

ADA Recommendations for Sealant Usage

- Reduces bacteria
- Resin-based are more "retentive"
- Mechanical preparation is not recommended (what about aprismatic enamel?)
- Use of self-etch bonding agents is not recommended
- Total etch bonding systems improve retention
- Four-handed application technique

- Glass Ionomer may be the material of choice if isolation is compromised or in moist environment. (improved “seal” vs. improved “retention”, fluoride delivery system, surface protection