The Art and Science of CAMBRA: A team approach using chemical treatments and minimally invasive dentistry.

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 minimally invasive approaches to managing 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:

- Biofilm-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 and Lactobacillus (aciduric and acidogenic; pH 3.8-4.8)
- other low pH non-MS bacteria
- pH rather than sugar determines how a biofilm will behave
- low pH can make otherwise healthy bacteria aciduric and acidogenic

Demineralization/Remineralization Process

Tooth Composition:

- Enamel = 85% mineral by volume and 15% by volume lipid, protein, and water
- Dentin & Cementum = 47% by volume mineral and 53% by volume 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

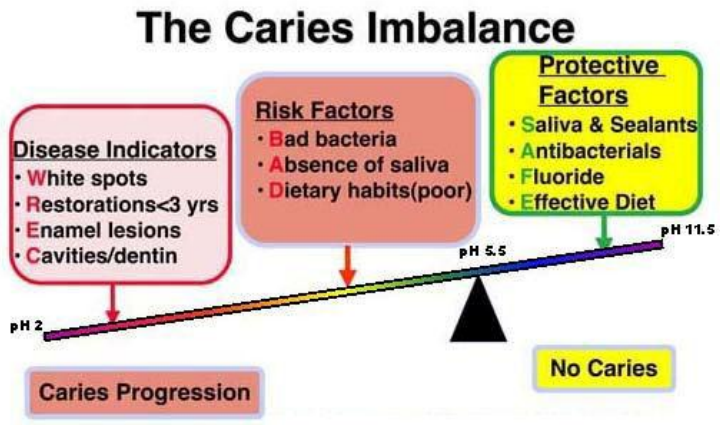
Demineralization Process

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



Disease Indicators

Indicative of past caries history or current activity and is the best predictor of future caries reactivity

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

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

- 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

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

Traditional Caries Detection

Diagnostic Values

- Sensitivity (SE): the probability that a test will correctly identify demineralization
- Specificity (SP): the probability that the test will correctly identify sound enamel
- 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 "stick")
- 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 secs. 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

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

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 Detection Technologies

Needed because the changes 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

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 Flourescence (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

Red–Infrared Reflectance (Midwest Caries ID)

www.cariesid.com

- Detects 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

Risk Factor Management

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

PATHOLOGICAL FACTORS

Carciogenic Bacteria

- Mutans streptococci (*S* mutans & *S* sobrinus)
- Lactobacilli colonize
- Levels $\geq 10^5$ CFU/ml = a high risk

Baseline Levels should be established for

- High-risk patients
- Mothers
- New Patients

Monitor change in levels

Salivary Dysfunction

- Stimulated Flow Rates
  - $\geq$ 1ml/min = Normal
  - 0.7 ml/min = low (dry)
- Low flow rate places patient at extreme risk

Poor Dietary Habits

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

PROTECTIVE FACTORS

Antibacterial Therapy

- Indicated for high challenge of MS, LB, and low pH non-MS bacteria
- 0.12% *Chlorhexidine Gluconate*
  - Reduces MS; not effective against LB
  - 10 ml 1 min Bedtime 1 week/month
    Follow with 3 weeks NaF rinse

- *CariFree Treatment Rinse (Oral BioTech)*
  - Sodium Hypochlorite, fluoride, Xylitol, pH buffer
  - 10 ml 1 min Bedtime 2 week/month
    Follow with 2 weeks CariFree Maintenance Rinse

-*10% povidone iodine*
  - Reduces MS & LB in studies on children in the operating room (high contact times)
  - Professional application only
  - Swish 10 ml for 1 min was not effective in adult pilot studies

- *pH Modification*
  - Selects for a non-pathogenic biofilm
  - Promotes remin
  - Stops demin

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

Topical Fluoride

- Inhibits bacterial metabolism
- Inhibits demineraliazation
- Enhances remineralization

Calcium and Phoshate

- Required for remineralization
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Saliva

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

Saliva Products

- Buffering products
- Artificial salivas
- Xerostomia products

Protective Factors: Antibacterial Agents

*Chlorhexidine Gluconate *see table above*

*Sodium Hypoclorite (CariFree Treatment Rinse /Oral BioTech) *see table above*

*Iodine *see table above*

*Xylitol *see table above*

Protective Factors: Fluoride, Calcium Phosphate

Fluoride Sources

Systemic 1000 – 2000 ppm in outer material; 20 – 100 ppm in subsurface during tooth development

Topical 30,000 ppm

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% SnF2
- Sodium monfluorophosphate 0.76% Na3PO3F

Rx dentrifice 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
- 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 D1

ADA Clinical Recommendations for Fluoride

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

Calcium Phosphate Technologies

Increase the amount of Ca & PO available to the surface to increase concentration gradient and promote remineraliazation

- Casein Phosphopeptide Amorphous Calcium Phosphate: CPP – ACP
  - Recaldent
- Calcium Sodium Phosphosilicate: CSP
  - NovaMin
- Amorphous Calcium Phosphate: ACP
  - ADA Foundation
- Tri Calcium Phosphate - TCP
  - Vanish XT, ClinPro 5000

ACP (ADA Foundation)

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

CPP – ACP (Recaldent/MI Paste/GC America))

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

Novamin (SootheRx /3M)

- Uses bioactive silica as carrier for Ca & PO
- Release Ca & PO immediately upon interaction with saliva
- Directly forms HCA – hydroxycarbonate apatite
- Continual release for up to 2 weeks post application

Tri Calcium Phosphate – TCP (Vanish XT, ClinPro 5000/3M)

- When blended/milled with organic materials
- Calcium – phosphate bonds are broken
- Calcium oxides become ‘protected’ by the organic materials
- Demonstrated by an increase in free phosphates after milling
- Process allows the Innovative TCP ingredient to coexist with fluoride ions in an aqueous dentifrice base ◊ High fluoride availability

Pit and Fissure Sealants

Remain most effective means for arresting or reversing early occlusal lesions.

Sealing Incipent Lesions

- Inhibist 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 task
    - Tooth risk
- Monitoring/re-appliacation

Sealant Technology

- Resin-based
- Glass-ionomer
- Self-cure vs. light cure
- Filled vs. unfilled
- Fluoride vs. no fluoride

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
- Glass ionomer OK if no rubber dam or moisture contamination possible