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 **Ca5 (PO4, CO3)3(OH)**
    - Calcium deficient
    - Carbonate-rich areas are more susceptible to acid attack

Demineralization 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, form 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 + hypo salivation)
- 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 Luminenscence

- 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"

7. Recommended Therapies

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% SnF2
  - Sodium monofluorophosphate
    - 0.76% Na3PO3F
- 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
    - Acefulfame 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 & PO4 available to tooth surface
    - To increase concentration gradient and promote remineralization
- ADA Foundation ACP
- CPP-ACP
- NovaMin®
- 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 & PO4
- Release Ca & PO4 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^{th} width of human hair)
- Mimic building blocks of natural enamel and effective as enamel repair
- Anticaries agent

8. Pit and Fissure Sealants

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

9. Bibliography

ADA Council on Scientific Affairs, Recommendations for Topical Fluoride Application, JADA Nov.2013.

ADA: Evidence-based clinical recommendations for the use of pit-and-fissure sealants. A report of the American Dental Association Council on Scientific Affairs. JADA, Vol. 139. March 2008

ADA Council on Scientific Affairs Evidence-based clinical recommendations for Professionally applied topical fluoride, JADA, Vol. 137 http://jada.ada.org August 2006

Adair, S. The role of sealants in caries prevention programs. JCDA March, 2003. Slide 199, 202, 206

Allaker RP. The Use of Naoparticles to Control Oral Biofil, Formation. J Dent Res 89, no. 11 (2010): 1175-1186.

Al-Sabbagh, Mohanad. "Etiology and Predisposing Factors to Dentin Hypersensitivity." Clinician's Guide to the Diagnosis and Management of Tooth Sensitivity. Springer Berlin Heidelberg, 2014. 23-39

Bader JD, Shugars, DA. A systematic review of the performance of a laser fluorescence device for detecting caries. JADA 2004 135, 1413-1426.

Bagramian RA, Garcia-Godoy F, Volpe AR. The Global Increase in Dental Caries: A Pending Public Health Crisis. Am J Dent 22, no. 1 (February 2009): 3-8.

Beauchamp et al. Evidence-based clinical recommendations for the use of pit & fissure sealants. JADA 2008 March;139(3) 257-68.

Beltran-Aguilar ED, Goldstein JW, Lockwood SA. Fluoride varnishes: A review of their clinical use, cariostatic mechanism, effiicacy, and safety. JADA 2000;May 131(5):589-96.

Birch, S., Bridgman, C., Brocklehurst, P., Ellwood, R., Gomez, J., Helgeson, M., ... & Preshaw, P. M. (2015). Prevention in practice–a summary. *BMC oral health*, *15*(Suppl 1),

Bonecker M, Grossman E, Cleaton-Jones PE, Parak R. Clinical, histological and microbiological study of hand-excavated carious dentine in extracted permanent teeth. SADJ 2003; 58(7): 273-8.

Burwell AK, Litowski LJ and Greenspan DC. Calcium sodium phosphosilicate (NovaMin): remineralization potentional. Adv Dent Res 2009;21:35-39.

Cheng, J., Chaffee, B. W., Cheng, N. F., Gansky, S. A., & Featherstone, J. D. B. (2015). Understanding Treatment Effect Mechanisms of the CAMBRA Randomized Trial in Reducing Caries Increment. *Journal of dental research*, *94*(1), 44-51.

Carvalho CK, Bezerra AC. Microbiological assessment of saliva from children subsequent to atraumatic restorative treatment (ART). Int J Paediatr Dent. 2003; 13(3): 186-92.

Dye, Bruce A., et al. "Dental Caries and Sealant Prevalence in Children and Adolescents in the United States, 2011-2012." *National Center for Health Statistics, data brief* 191 (2015).

Domejean S, White JM, and Featherstone JDB, Validation of the CDA CAMBRA Caries Risk Assessment – A Six-Year Retrospective Study, J Calif Dent Assoc 39, no. 10 (2011): 709-15.

Edelstein BL. Environmental factors in implementing the dental home for all young children. Available at: www.cdhp.org/system/files/1.%20Implementing%20the%20Dental%20Home.pdf

Environmental Protection Agency (US). Fluoride: exposure and relative source contribution analysis. Washington: EPA, Office of Water, Health and Ecological Criteria Division; 2010. Also available from: URL: http://water.epa.gov/action/advisories/drinking /upload/fluoridereport.pdf [cited 2014 Dec 4].

Erickson et al. Soft Drinks: Hard on Teeth. J Minn Dent Assoc March-April 2001:15-19.

Erten H, Uctasli MB, Akarslan ZZ, et al. The assessment of unaided visual examination, intraoral camera and operating microscope for the detection of occlusal caries lesions. *Oper Dent.* 2005;30(2):190-194.

Featherstone. The Science and Practice of Caries Prevention. JADA Vol 131 July 2000.

Featherstone et al. Caries risk assessment in practice for age 6 thru adult. J CDA Oct 2007 Vol 35 (10):703-13.

Featherstone JDB, Gansky SA et al. A randomized clinical trial of caries management by risk assessment. Caries Res 39:295, 2005.

Featherstone JDB. Caries Prevention & Reversal Based on the Caries Balance, Pediatric Dentistry28:2; 128-32

Featherstone JDB. The Science and Practice of Caries Prevention, JADA, Vol 131, July 2000: 887-899 .

Featherstone, John DB. "18 Dental Caries Management by Risk Assessment." *Dental Hygiene: Theory and Practice* (2014): 294.

Forgie AH, Pine CM, Pitts NB. The use of magnification in a preventive approach to caries detection. *Quintessence Int*. 2002; 33(1):13-16.

Frencken JE, Leal SC, Navarro MF. Twenty-five-year atraumatic restorative treatment (ART) approach: a comprehensive overview. Clin Oral Investig 2012; 16(5): 1337-46.

Gati, Daniel, and Alexandre R. Vieira. "Elderly at greater risk for root caries: a look at the multifactorial risks with emphasis on genetics susceptibility." *International journal of dentistry* 2011 (2011).

Gould, ED. Atraumatic restorative treatment. Access. Feb 2013, 24-25.

Hagel N and Vannah D. “Seal Away Caries Risk.” *Dimensions of Dental Hygiene*. June 2015;13(6):34,36

Haywood VB. Bleaching and caries control in elderly patients. Aesthetic dentistry today, 42-44

Huang SB, Gao S, and Yu HY. Effect of Nano-hydroxyapatite Concentration on Remineralization of Initial Enamel Lesion In Vitro. Biomed Mater 4, no. 3 (2009): 034104.

Hujoel PP, Mäkinenkk, Bennett CB, Isokangas PJ, Isotupa KP, Pape HR Jr, Lamont Rj, DeRouen TA, Davis S. Do caries explorers transmit infections with persons? An evaluation of second molar caries onsets. Caries Res 1995;29(6):461-6.

Hurbutt M, Novy B, Young D. Dental Caries: A pH-mediated disease. CDHA Winter, 2010.pp 9-15

Ito A, Hayashi M, Hamasaki T, Ebisu S, Risk assessment of dental caries by using Classification and Regression Trees. J Dent (2011) Jun 39 (6): 457-63.

Jackson R, Fontana M. Preventing the Progression. Dimensions in Dental Hygiene, July 2006; 4(7):28, 30-31

Jefferies, Steven R. "Advances in Remineralization for Early Carious Lesions: A Comprehensive Review." *Compendium of continuing education in dentistry (Jamesburg, NJ: 1995)* 35.4 (2014): 237-243.

Kolenbrander PE, “Oral Microbial Communities: Biofilms, Interactions, and Genetic Systems, “ Annual Rev Microbiol 54 (2000): 413-437.

Lazarchik DA, Haywood VB. Use of tray-applied 10 percent carbamide peroxide gels for improving oral health in patients with special-care needs. JADA June 2010, 141 (6):639-646.

Leo M. Sreebny and Arjan Vissink, Dry Mouth, the Malevolent Symptom: A Clinical Guide. Hoboken, NJ: Wiley-Blackwell, (2010), 92.

Loesche, WJ, Svanberg, ML, Pape HP, (1979). Intraoral transmission of Streptococcus mutans by a dental explorer. Journal Dental Research, 58, 1765-1770.

Long, Feixiao, et al. "Dental imaging using laminar optical tomography and micro CT." *SPIE BiOS*. International Society for Optics and Photonics, 2014.

Lussi A, Jaeggi T. Chemical factors. Monograph Oral Science 2006;20:77-87.

Marsh PD. Dental Plaque as a Biofilm: The Significance of pH in Health and Caries, CompendContinEduc Dent 30, no. 2 (March 2009): 76-8.

Marsh PD. Microbial ecology of dental plaque and its significance in health and disease. Adv. Dent. Res. 1994; 8:263-71.

Marsh P, Marsh Schematic of Ecological Plaque Hypothesis, Oral Microbiology: 116.

Mei, May L., et al. "Inhibitory effect of silver diamine fluoride on dentine demineralisation and collagen degradation." *Journal of dentistry* 41.9 (2013): 809-817.

Milosevic, A. A Sports drinks hazard to teeth. British Journal of Sports medicine 1997: 31:28-30.

John, Mini K., Anulekh Babu, and Anupama S. Gopinathan. "Incipient caries: an early intervention approach." *International Journal of Community Medicine and Public Health* 2.1 (2015): 10-14.

Minocha A, Probiotics for Preventive Health, Nutr Clin Pract 24, no.2 (April-May 2009): 227-41.

McCann, D. Taking the Fight to Caries. Dental Practice Report, March 2006. pgs.30-38

Nayak, Prathibha Anand, Ullal Anand Nayak, and Vishal Khandelwal. "The effect of xylitol on dental caries and oral flora." *Clinical, cosmetic and investigational dentistry* 6 (2014): 89.

Nederfors T, Xerostomia: Prevalence and Pharmacotherapy, with Special Reference to Beta-adrenreceptor Antagonists. Swed Dent J 116, Suppl (1996): 1-70.

Neiderman R, Gould E, Soncini J et al. A model for extending the reach of the traditional dental practice; the ForsythKids program. J AM Dental Association. 2008; 139(8): 1040-50.

Niederman R. Children's Oral Health Conference PowerPoint Presentation, "Caried Away in CO, HI, KS, ME, NH," 27 September 2012. Available at: www.oralhealthcolorado.org/be-a-smart-mouth/resources

Neural Gugnani, IK Pandit, Nikhil Srivastava, Monika Gupta, and Shalini Gugnani, J Conserv Dent. 2011 Oct-Dec; 14(4): 418–422.

P. D. Marsh, "Dental Plaque as a Biofilm and a Microbial Community-Implication for Health and Disease," BMC Oral Health 6, Suppl. 1 (2006): S14.

Pew Center on the States. The state of children's dental health: making coverage matter. Available at www.pewstates.org/uploaded Files/PCS_Assets/2011/The_State_of_Childrens_Dental_health.pdf.

Radike AW. Cirteria for diagnosis of dental caries. In: Proceedings of the Conference on the Clinical Testing of Cariostatic Agents, American Dental Association, Chicago, Illinois, October 14-16, 1968. Chicago: ADA Council on Dental Research; 1972: 87-8.

Riley P, Moore D, Ahmed F, Sharif MO, Worthington HV. Xylitol-containing products for preventing dental caries in children and adults. Cochrane Database of Systematic Reviews 2015, Issue 3. Art. No.: CD010743. DOI: 10.1002/14651858.CD010743.pub2

Riley, Philip, et al. "Xylitol-containing products for preventing dental caries in children and adults." *The Cochrane Library* (2015).

Roberts, Michael W, Wright, J Timothy. Nonnutrive, Low Caloric Substitutes for Food Sugars: Clinical Implications for Addressing the Incidence of Dental Caries and Overweight/Obesity. Int J Dent, 2012: 625701.

Robertson MA, Chung HK, English JD, Lee RP, Powers J, Nguyen JT. MI Paste Plus to prevent demineralization in orthodontic patients: A prospective randomized control trial. *Am J Ortho and Dent Ortho.* Nov 2011;140(5):660-668

Rosan B, Lamont RJ, Dental Plaque Formation, Microbes Infect 2 (2000): 1599-607.

Sharif, Mohammad O., Farooq Ahmed, and Helen V. Worthington. "Xylitol-containing products for preventing dental caries in children and adolescents." *The Cochrane Library* (2015).

Spolsky et al. Products – Old, New, and Emerging. JCDA Feb 2003

Stegeman, Cynthia. Mosby's Dental Hygiene, Daniel & Harfst, 2002. Ch. 18 pgs 347-351.

Stookey G. QLF: A Technology for Early Monitoring of the Caries Process. Dent Clin N Am 49(2005) 753-770.

Strassler HE, Syme SE, Serio F, et al. Enhanced visualization during dental practice using magnification systems. *Compend Contin Edu Dent.* 1998;19(4):595-602.

Tanaka T, Yagi N, Ohta T, Matsuo T, Terada H, Kamasaka K, To-o K, Komentani T, Kuriki T. Evaluation of the Distribution and Orientation of Remineralized Enamel Crystallites in Subsurface Lesions by X-ray Diffraction. Caries Res 44, no. 3 (2010): 253-9.

Takikawa R, Fujitsu K, Ishizaki T, Hayman RE. Restoration of Post-bleach Enamel Gloss Using a Non-abrasive, Nano-hydroxyapatite Conditioner, J Dent Res Special Issue B (Brsibane Abstracts; 2006): 85.

Tellez M, Gray SL, Gray S, et al. Sealants and dental caries: dentists' perspectives on evidence-based recommendations J Am Dent Assoc. 2011; 142(9): 1033-40.

Twetman, S. (2015). The evidence base for professional and self-care prevention-caries, erosion and sensitivity. *BMC oral health*, *15*(Suppl 1), S4.

Urban, Ruth A., and Dorothy J. Rowe. "Knowledge, Attitudes and Practices of Dental Hygienists Regarding Caries Management by Risk Assessment." *American Dental Hygienists Association* 89.1 (2015): 55-62.

US Dept of Health and Human Services. Oral Health in America: A Report of the Surgeon General 2000. www.surgeongeneral.gov/library/oralhealth. ADA Clinical Recommendations for use of pit & fissure sealants 2008.

Wambier DS, dosSantos FA, Guedes-Pinto AC, Jaeger RG, Simionato MRL. Ultrastructural and microbiological analysis of the dentin layers affected by caries lesions in primary molars treated by minimal 88 intervention. Pediatr Dent. 2007; 29(3): 228-34.

Weintraub, Jane A., et al. "Fluoride varnish efficacy in preventing early childhood caries." *Journal of Dental research* 85.2 (2006): 172-176.

Yanase, Roy T., and Hamilton H. Le. "Caries Management by Risk Assessment Care Paths for Prosthodontic Patients: Oral Microbial Control and Management." *Dental clinics of North America* 58.1 (2014): 227-245.

Yoon RK, Smaldone AM, Edelstein BL. Early childhood caries screening tools:a comparison of four approaches, J Am Dent Assoc. 2012 Jul; 143(7):756-63

Young & Featherstone, Mosby's Dental Hygiene, 2002, Chapter 22, pgs. 390-393.

Young DA, Featherstone JD, Roth JR. Curing the silent epidemic: caries management in the 21st century and beyond. J Calif Dent Assoc. 2007;35(10):681-685.
Zandona AF, Zero DT. Diagnostic tools for early caries detection. JADA, Vol 137. December 2006, pgs 1675-1684.

Zhi, Qing Hui, Edward Chin Man Lo, and Huan Cai Lin. "Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children." Journal of dentistry 40.11 (2012): 962-967.

10. Websites Referenced

www.aapd.org
www.academyofgeneraldentistry.com
www.ada.org
www.adha.org
www.cdafoundation.org
www.cdhp.org
www.dmg-america.com
www.healthcare-online.org
www.isds.org
www.mndental.org "Sip All Day, Get Decay®"
www.nidcr.nih.gov
www.nytimes.com
www.public.health.oregon.gov
www.takepart.com
www.rdhmag.org

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