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The Paradigm Shift in Prevention and Treatment of Caries

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COURSE AUTHOR

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COURSE OBJECTIVES

The new etiology, prevention, and treatment of dental caries demands that clinicians redirect their energies toward detecting caries lesions early so that non-cavitated lesions can be reversed or arrested from progressing by chemical means rather than through "restoration." This course discusses this shift from the classical restorative approach to caries management. Upon completion of the course, the participant will have gained a more thorough understanding of: caries-causing bacteria; remineralization of tooth enamel; the importance and means of early detection; establishment of the dental home; vertical transmission of S. mutans; risk assessment of the pediatric patient, and intervention strategies.

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WHY TAKE THIS COURSE?

PATIENT CARE—The classical restorative approach to the treatment of caries does not address the basic cause of the disease. With early detection, non-cavitated lesions can be reversed or arrested from progressing by chemical means rather than restoration.

CE CREDITS—Successful completion of this course earns you 4 Continuing Dental Education Units.

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All Dentists, EFDAs, CDAs, Dental Assistants, Dental Hygienists

The Paradigm Shift in Prevention and Treatment of Caries

CAUSES OF DENTAL CARIES

The fact that dental caries is an infectious and transmissible disease has been acknowledged for more than four decades, but has only recently become widely accepted. Dental caries arises from an overgrowth of specific organisms that are part of normally occurring human dental flora. The mutans streptococci group, which includes Streptococcus mutans and Streptococcus sobrinus, as well as several lactobacilli species are considered to be the principal groups of bacteria that are cariogenic or acidogenic (acid producing) as well as aciduric (acid tolerant) and are responsible for dental caries.

These bacteria are all called acidogenic because they produce acids from carbohydrates. These acids include lactic, acetic, propionic and formic. When the acids are produced by the bacteria, they diffuse into the tooth enamel or dentin and dissolve or partially dissolve the mineral from crystals down inside the tooth. The tooth enamel and dentin are tissues made up of millions of tiny crystals. The mineral involved is termed a carbonated hydroxyapatite. This is a calcium phosphate with numerous impurity inclusions, the most important of which is the carbonate ion, which makes the mineral more acid-soluble than pure hydroxyapatite. If the dissolving of the mineral is not halted or reversed, the early subsurface lesion becomes a cavity.

The reversal of the process is remineralization (replacement of mineral), which occurs when the acid in the plaque is buffered by saliva allowing calcium and phosphate, primarily from the saliva, to flow back into the tooth and form new mineral on the partially dissolved subsurface crystal remnants. The new "veneer" on the surface of the crystal is much more resistant to subsequent acid attack, especially if it is formed in the presence of sufficient fluoride.

Based upon the above summary of our in-depth knowledge of the caries process, it is very useful and constructive clinically to consider caries in its progression or reversal as an ongoing and often changing balance between pathological factors and protective factors. If the pathological factors outweigh the protective factors, then caries progresses. In the reverse situation, caries is arrested or even reversed. The pathological factors include the acidogenic bacteria, reduced salivary function, and the frequency of ingestion of fermentable carbohydrates. The protective factors include saliva and its numerous caries-protective components: the saliva flow; antibacterials, both intrinsic from saliva and extrinsic from other sources; and other factors that can enhance remineralization.

PARADIGM SHIFT

Treatment of dental caries as an infectious disease will require a paradigm shift in the way dentists and other health care professionals approach prevention and management of the disease. The historical approach to the management of dental caries, once demineralization and cavitations have occurred, consists of the removal of the diseased tissue (enamel and dentin) and replacing it with a restorative material such as amalgam, precious metal, or one of the newer composite materials. In extreme cases where bacterial necrosis of the dental pulp has occurred, the method of treatment becomes surgical removal of the tooth or endodontic therapy followed by prosthetic restoration. All of this is likely to be time-consuming, costly, and sometimes painful for the patient.

In all of these classical restorative approaches to caries management, the basic cause of the disease – the specific acidogenic bacteria in the plaque biofilm on the remainder of the teeth in the mouth – remains intact and capable of creating new areas of decalcification and eventual cavitation should the enabling environmental modifiers be present.

Dentists are justifiably proud of and proficient in the art and science of restorative dentistry and of their ability to deliver these services in a relatively comfortable and safe fashion to the very young or apprehensive patient. This paradigm shift in the etiology, prevention, and treatment of dental caries, however, demands that clinicians redirect their energies and seek to detect caries lesions early enough so that the early, noncavitated lesion can be reversed or at least arrested from progressing by chemical means rather than by "restoration" (placing fillings).

EARLY DETECTION

Radiographs as done with "bitewings" have long been useful for detecting interproximal lesions. The current standard of care is that if an enamel lesion, as detected by the radiograph, is not past the dentino-enamel junction, then it can be arrested or reversed by remineralization, whereas an opacity into the dentin requires a restoration. This method is quite reliable for these lesions. However occlusal surfaces are very different. In this case, there is a large amount of surrounding sound enamel that absorbs the X-rays; and only an advanced lesion can be detected in this fashion with conventional bitewing radiographs. We need methods that can detect occlusal lesions while they are still in the enamel and can be reversed or arrested by fluoride therapy and remineralization.

NEW INSTRUMENTS

Recently, the FDA approved a device called the Diagnodent (KaVo), which shines a red laser into the tooth via a specially designed handpiece and tip. The tip is applied to the occlusal pits and fissures individually. The red light readily penetrates the tooth; and if it interacts with a subsurface lesion that contains certain bacterial byproducts, fluorescence is produced. The fluorescent light comes back from the lesion into the handpiece, interacts with the detector, and is read out as a number and an audible signal if there is a lesion. This instrument is a good first step in providing the practitioner with a tool that can indicate whether there is a hidden lesion under the occlusal surface.

RISK ASSESSMENT

The arrest and reversal of the caries process does not always require the identification of the specific teeth with lesions, but as mentioned before, can be accomplished by using antibacterials, both intrinsic from saliva and extrinsic from other sources, reducing frequency of ingestion of fermentable carbohydrates, and implementing other steps that enhance remineralization. While many of these practices would be beneficial to every dental patient, they are particularly important for those individuals who are at high risk of developing cavities. These people can be identified and treated by conducting a risk assessment on every dental patient. The guiding principle (risk factor) questions for this risk assessment tool should be as follows:

1. Are there existing, or have there been, new untreated cavities in the past two years?
2. Have there been orthodontic appliances or removable partial dentures?

3. Is there reduced salivary function as measured by stimulated saliva flow less than 0.7ml/minute?
4. Is there use of hyposalivatory medications?
5. Is there frequent ingestion of fermentable carbohydrates? (Determined by questioning the patient.)
6. Is current use of fluoride products inadequate?
7. Is there high caries bacterial challenge as measured by testing mutans streptococci and lactobacilli?

The number of 'yes' answers to the above questions places the patient into one of three risk categories. If the answers to the first five questions are mostly no, then bacterial testing is not needed. If bacterial testing is needed, the Ivoclar caries resistance test is used, and results are known in 48 hours. This forms the basis for future monitoring of the effectiveness of antibacterial therapy. If the person is at high risk, this initiates:

- Bacterial testing (Culture media, immuno assays and enzymatic procedures as well as molecular biological techniques help identify and quantify bacteria);
- Fluoride therapy (fluoride office topical followed by higher concentration home use fluoride is used);
- Chlorhexidine therapy (0.12% chlorhexidine gluconate for two weeks daily every three months);
- Regular recall to monitor lesion progress or arrestment and antibacterial therapy success.

ESTABLISHMENT OF THE "DENTAL HOME"

The concept of the dental home is derived from the American Academy of Pediatrics concept of the "medical home." The American Academy of Pediatrics states, "The medical care of infants, children, and adolescents ideally should be accessible, continuous, comprehensive, family centered, coordinated, compassionate, and culturally effective. It should be delivered or directed by well-trained physicians who provide primary care and help to manage and facilitate essentially all aspects of pediatric care." Pediatric primary dental care must be delivered in a similar manner. The dental home is a specialized primary dental care provider within the philosophical complex of the medical home. Referring a child for an oral health examination by a dentist who provides care for infants and young children 6 months after the first tooth erupts or by 12 months of age establishes the child's dental home and provides an opportunity to implement preventive dental health habits that meet each child's unique needs and keep the child free from dental or oral disease.

For the pediatric patient, as for the general patient, it is important to determine who is at high risk for the development of caries. The vertical transmission of S. mutans from mother to infant is well-documented. In one study, it was shown that genotypes of S. mutans in infants matched those present in mothers in approximately 71% of mother-infant pairs. Thus, children of high-caries-index mothers are at a higher risk of decay. Consequently, risk assessment of the child also involves assessment of the mother's caries and examination of her dentition. Mothers with active decay and/or multiple fillings in multiple quadrants of the mouth are at higher risk than those who have never experienced decay or have but one or two restorations. Regardless of the parent's caries activity, it is generally agreed that infants who fall into one of the following categories should be considered high risk:

- Children who are medically compromised;
- Children of mothers with a high caries rate;
- Children with demonstrable caries, plaque, demineralization, and/or staining;
- Children who sleep with a bottle or at the breast all night;
- Later – older siblings of a parent with mildly to moderately high caries rate;
- Children in families of low socioeconomic status.

An infant is most readily colonized with normal dental flora after the eruption of the primary dentition, which usually occurs from 6 to 30 months of age, though recent studies have shown that some colonization occurs even before teeth erupt. Therefore, an oral health risk assessment before 1 year of age affords the opportunity to identify high-risk patients and to provide timely referral and intervention for the child. It also allows an invaluable opportunity to decrease the level of cariogenic organisms in the mother with a significant caries risk before and during colonization of the infant which can in turn significantly impact the child's caries rate. Mothers should also be educated to prevent early colonization of dental flora in their infants by avoiding sharing of utensils (i.e., shared spoons, cleaning a dropped pacifier with their saliva, etc).

If, upon examination, significant plaque is present on any of the child's teeth or they are noted to have white lesions or areas of decalcification, the infant should be considered at high risk for caries. As such, the infant should be referred to a dentist who treats infants and toddlers who will implement intervention strategies such as the application of antimicrobials, fluoride therapy, etc.

Despite the importance of early assessment for children, a study of dental referral practices among primary care faculty pediatricians at four medical centers revealed that none of the respondents reported referring their patients to a dentist before the first birthday as recommended by the AAPD. In addition, 60% of the pediatricians surveyed referred children only by 3 years of age to a dentist for an oral examination. By then, dental decay can be well advanced.

EARLY INTERVENTION STRATEGIES

Saliva plays an important role in the prevention of caries by repelling bacteria in the oral cavity and transporting important components such as remineralizing ions, buffer systems, enzymes, and proteins. If the salivary glands, however, are not producing the quantity they should (in an adult, at least one milliliter per minute), saliva cannot assume its natural protective function. A reduction in saliva production may occur in the following cases:

- Intake of medications such as antidepressants, analgesics, antihistamines, or appetite suppressants to name only a few
- Certain systemic illnesses such as autoimmune diseases (Sjögren's syndrome, rheumatoid arthritis) and HIV-infection
- Radiation of the head
- Stress

In the dental office, the salivary flow rate is determined to obtain important information about the health of the individual and for developing suitable treatment measures. It is easier to collect saliva from a patient if he or she chews on some paraffin for a specific period of time than it is to obtain resting saliva.

A special test is used to assess the buffer capacity (i.e., to what extent the saliva is capable of neutralizing acids that may harm the tooth structure). If the saliva is no longer capable of providing enough protection, the dental office may provide such treatment measures as routine professional cleaning, antimicrobial treatments, promotion of remineralization with products

containing fluoride, and sealing of particularly susceptible tooth surfaces as well as the prescription of artificial saliva preparations if necessary.

Affected patients should supplement these measures by a suitable maintenance program at home. Oral hygiene regimens as well as the use of chlorhexidine (CHX) and/or fluoride-containing preparations for at-home use are available to support the measures carried out in the dental surgery. Saliva can be stimulated by drinking a lot of water, eating food that needs to be chewed well, and chewing sugar-free gum.

DIETARY MODIFICATIONS

Although ECC is an infectious disease, the role of diet in acquisition of the infection and development of the disease is critical. Children with ECC have frequent and prolonged consumption of sugars from liquids. Caries-promoting sugars such as sucrose, glucose and fructose, contained in fruit juices and many infant formula preparations, are readily metabolized by S. mutans and lactobacilli to organic acids that demineralize enamel and dentin. The use of nursing bottles and "sippy cups" enhances the frequency of exposure. This type of feeding behaviour during sleep intensifies the risk of caries, as oral clearance and salivary flow rate are decreased during sleep. In addition, caries-promoting feeding behaviors result in an increase in the magnitude of dental reservoirs of S. mutans.

Recommendations that required significant modification of feeding behaviors, however, have had minimal impact. Consequently, clinical outcomes for treatment of ECC have been poor. Sheehy and others, using a telephone survey, found that 23% of children treated for ECC under general anesthesia required restorations or extractions after the initial dental surgery. In another study, 52% of the cohort treated under general anesthesia presented with new smooth-surface enamel lesions within 4–6 months after dental surgery. Eidelman and others, using a retrospective chart review, reported that 57% of the study cohort who had been treated under general anesthesia required treatment for new carious lesions within 6–24 months after the initial dental surgery.

A number of studies conducted among schoolchildren of various ages have shown that consumption of gum containing xylitol (an FDA approved sweetener) reduces the rates of dental decay in the treatment groups (relative risks ranging from 0.27 to 0.56). Increasing use and higher doses lead to greater reductions. One study conducted among schoolchildren in Belize with very high rates of dentine caries showed that consumption of xylitol gum was associated with arrest of carious lesions and, as expected, that the highest dose of xylitol had the greatest effect. This study is important because the children continued to consume very high levels of sucrose in their everyday diet.

The use of xylitol is particularly attractive because its action is not dependent upon reducing the amount of other sugars in the diet. Thus, a clinician can recommend adding xylitol to the diet without asking patients to make additional alterations to their dietary patterns.

Xylitol is a sugar substitute with sweetness equal to that of table sugar. It is a member of the group of compounds known as sugar alcohols, which includes other common dietary sweeteners such as sorbitol and mannitol. Xylitol is produced commercially from birch trees and other hardwoods containing xylan. It can also be found in small quantities in fruits and vegetables. In contrast, sorbitol, commonly found in sugar-free products such as chewing gum, candies, and toothpaste, is less sweet than sucrose and is generally combined with other sweeteners such as saccharine or aspartame as well as xylitol to improve the flavor of the product.

Xylitol contains 40% fewer calories than sucrose. Because xylitol is absorbed slowly by the human gastrointestinal tract, the main side effect associated with its consumption is osmotic diarrhea. This usually occurs only when xylitol is consumed in large quantities, four to five times those needed for the prevention of dental caries. This side effect is common to all sugar alcohols.

Xylitol has been found to accumulate intracellularly in S. mutans. This accumulation inhibits the bacteria's growth. This has been demonstrated in-vitro and may contribute to a reduction of S. mutans levels in the plaque and saliva of those consuming xylitol. Short-term consumption of xylitol is associated with decreased S. mutans levels in both saliva and plaque. Long-term habitual consumption of xylitol appears to have a selective effect on S. mutans, resulting in selection for populations less adherent to tooth surfaces. These colonies, therefore, are shed more easily from plaque into saliva. This effect may not only be important to the individual's decay experience, but may also influence the transmission of S. mutans from mothers who consume xylitol to their children.

Other xylitol-containing products have been studied. A field trial of the use of xylitol-containing candies among 10-year-old schoolchildren in Estonia showed a 33% to 59% caries reduction in the groups using the candies and a 53.5% caries reduction in the group using the gum relative to the control group. This suggests that candy may be as effective as chewing gum as a vehicle for the delivery of xylitol in caries prevention. At the University of Washington, researchers have produced and field-tested xylitol-containing ice pops, chewy worms, puddings, macaroons, and sorbet. They have initiated studies that suggest that children will fairly readily accept such foods when offered as part of the daily diet and that they suffer no side effects from their use. Food producers are available to develop these foods, but considerable work is needed to produce commercially viable products and have them accepted.

FLUORIDE THERAPY

Although community water fluoridation was introduced more than 50 years ago, about 100 million Americans still do not have fluoride in their drinking water. The fluoridation process, which involves the adjustment of the natural fluoride level in a community's water system to the optimal level of about 1 part per million, has been shown to be a safe, effective, and inexpensive measure to reduce tooth decay by 30% to 50%. These decreases were seen in communities with varying levels of decay and among children of all socioeconomic levels.

Preparations containing fluoride also are an integral part of modern dental treatment measures. Varnish systems offer effective professional prevention and ensure long-term preservation of teeth. The product releases fluoride to inhibit demineralization processes and promote remineralization. In fact, initial caries lesions can be repaired by applying a fluoride varnish. The availability of small amounts of fluoride is key whatever the patient's age. Gels and rinsing solutions are available for patients to use at home. Tooth-paste containing fluoride has become a standard feature of daily dental care.

Fluoride tablets are not recommended as often as in the past, as their effect is largely based on a local mechanism, and patient compliance is necessary for effectiveness. However, the topical application of varnishes and gels in the dental surgery is becoming more accepted. For small children, it is particularly important to choose low-dose preparations, taking other fluoride sources such as tap and mineral water or table salt into consideration. Because children are not yet in command of the swallowing reflex, children's toothpaste should be used at home and a varnish with a low concentration of fluoride in the dental practice.

Antibacterial therapy with chlorhexidine (0.12% chlorhexidine gluconate for two weeks daily every three months) has proven effective for mutans streptococci but not for lactobacilli. Researchers are now studying the effectiveness of povidone-iodine against lactobacilli. In a study of Puerto Rican babies at high risk for ECC, bimonthly topical application of a 10% povidone-iodine solution to the dentition of babies at high risk for ECC increased disease-free survival. The study population consisted of 83 subjects who were 12 to 19 months of age at the time of their entry into the study who had no visible defects, were caries-free, used a nursing bottle containing a cariogenic substance at naptime, and had two consecutive S. mutans-positive cultures from pooled PMI plaque. The experimental group had a 10% povidone-iodine solution applied to the dentition bimonthly for one year. The authors estimated that 91% of experimental subjects experienced 12 months of disease-free survival compared to 54% of control subjects.

SEALANTS

The title of Michael Buonocore's 1955 paper in the Journal of Dental Research was unpretentious: "A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces." Few but the most perceptive researchers and clinicians foresaw the revolution that his discovery would bring to the fields of restorative dentistry, prevention, and orthodontics. Yet Buonocore's subsequent work led directly to the development of pit and fissure sealants, then to enamel bonding, bonded orthodontic brackets, dentin bonding, crown and bridge cements, and other uses. While the techniques and materials have evolved, the sealants we apply today to prevent pit and fissure caries are direct descendants of Buonocore's "simple method."

A CDC task force that examined the effectiveness of school-based dental sealant programs found that there was typically a 60% decrease in tooth decay on the occlusal surfaces of posterior teeth after sealant application. Yet currently, only 23% of 8-year-old children in the United States have dental sealants. The prevalence is far lower for children who may have a higher decay risk; only 3% of low-income children and only 11% of African-American children have received a dental sealant.

TECHNIQUE: THEN AND NOW

Initially, the sealant technique required prophylaxis of the tooth surfaces to be sealed; a 60-second etch with one of a variety of acids (typically 50% liquid phosphoric acid); variable rinse and drying times generally on the order of 30 seconds each; followed by application of an unfilled, UV light cured (later, autopolymerizing) sealant. Longer etch times were advocated for primary teeth. The technique was strictly non-invasive; in fact, that aspect of the technique was touted as one of its attractions.

In current practice, etch times are down to 10 to 20 seconds, etchants are less concentrated liquids and gels (typically 37% phosphoric acid), and some degree of fissure preparation via rotary instruments or air abrasion is increasingly common. An almost bewildering array of filled and unfilled, tinted and clear, fluoride-releasing and non-releasing, self-curing and visible light-cured materials is available. Other materials that have been tried as sealants include flowable composites, glass ionomer cements, and even amalgam. Bonding agents have been shown to increase sealant retention, especially on enamel that has become contaminated with saliva after etching.

The major concern with sealants has been the inadvertent sealing of dental caries. This misapprehension has been put to rest by a number of studies showing that dental caries becomes arrested under intact sealants. These findings have largely served to comfort those clinicians who were concerned about sealing unrecognized caries. It is likely that few clinicians employ, and even fewer schools teach, intentional therapeutic use of sealants. However, as noted earlier, the sealant technique is becoming more invasive, so clinicians are more likely to ensure that sealants are not being placed over carious lesions. A second concern has arisen in recent years regarding the estrogenicity of sealant components. More recent work suggests that these components may not be absorbed, or that they may be present in nondetectable levels in the blood. Dentists can take steps to minimize the patient's exposure to uncured resin components after sealant placement.

SEALANT GUIDELINES

Before applying sealants, risk assessment of individual teeth based on pit and fissure morphology, level of caries activity, and caries pattern must be done. These assessments are followed by an evaluation of pit and fissure surfaces, with determinations of "caries-free," "questionable," "enamel caries," and "dentin caries." Sealant is recommended for teeth classified as "questionable" or "enamel caries," and for those caries-free teeth deemed to be at risk for caries. At this time, sealants are not recommended for teeth with dentinal caries. Sealants are also not recommended if the tooth cannot be isolated; if a proximal restoration involves a pit and fissure surface; or, in the case of a primary tooth, if the life expectancy of the tooth is short. In addition, the guidelines call for evaluation of previously sealed teeth for sealant integrity and retention.

Self-Test

1. The following is a disadvantage of the "restorative" approach to dental caries:

a. The specific acidogenic bacteria in the plaque biofilm on the remainder of the teeth in the dental patient's mouth remains intact and likely to eventually cause cavitation on some of the patients' teeth.
b. Decay removal is incomplete in the restorative approach.
c. Restorative procedures are timely and costly.
d. A & C.
e. All of the above.

2. TRUE or FALSE: The S. mutans is the only group of bacteria that is responsible for dental caries.

a. TRUE
b. FALSE

3. Which of the following factors can enhance remineralization:

a. Saliva
b. Amalgam
c. Flouride
d. Sealants
e. A & C.

4. Which of the following acids have been implicated in enamel crystal dissolution?

a. Lactic
b. Acetic
c. Propionic
d. Formic
e. All of the above.

5. Occlusal lesion detection poses a challenge to dentists because:

a. They are difficult to fill once the decay reaches the dentin of the teeth.
b. They generally do not respond well to fluoride therapy.
c. A disproportionate amount of dental flora often attaches itself to these teeth.
d. The large amount of surrounding sound enamel makes it difficult for x-rays to detect them.

6. TRUE or FALSE: If carious growth is detected before it goes past the dentino-enamel junction, it can often be arrested by remineralization.

a. TRUE
b. FALSE

7. Which of the following is NOT a factor to be considered in the risk assessment of a dental patient:

a. Is there reduced salivary function?
b. Does the patient brush before or after flossing?
c. Have there been new untreated cavities in the past two years?
d. Does the patient have orthodontic appliances?
e. Is there high caries bacterial challenge in the oral cavity?

8. A person at high risk for dental caries should do which of the following?

a. Have a fluoride treatment in the dental office but then continue to use a regular concentration of fluoride at home.
b. Return regularly to his dentist to monitor lesion progress.
c. A & B.
d. All of the above.
e. None of the above.

9. Which of the following places a child at high risk for caries?

a. Excessive contact sports.
b. The custom of sleeping with a bottle all night.
c. A mother with active decay.
d. Late eruption of baby teeth.
e. B & C.

10. TRUE or FALSE: Recent studies have shown that colonization of dental flora occurs even before teeth erupt.

a. TRUE
b. FALSE

11. Which of the following can a mother do to decrease an infant's level of cariogenic organisms?

a. Refrain from sharing utensils with him.
b. Increase the infant's fluoride intake.
c. Nightly gum massage.
d. Give Vitamin C supplements.
e. All of the above.

12. A reduction in saliva production may occur as a result of which of the following:

a. Intake of medications such as antidepressants, analgesics, or antihistamines.
b. Poor tooth brushing technique.
c. High blood pressure.
d. Excessive fluoridation.

13. TRUE or FALSE: It is easier to collect saliva from a patient who has not eaten or chewed on anything for at least an hour.

a. TRUE
b. FALSE

14. Which of the following does NOT stimulate saliva production:

a. Drinking a lot of water.
b. Dental x-rays.
c. Chewing wax.
d. Chewing gum.

15. Which of the following statements is true?

a. Since ECC is an infectious disease, diet plays far less of a role than once supposed.
b. For prevention of cavities, sugary bedtime snacks and juices are recommended.
c. Sleeping with a bottle of formula does not promote caries.
d. Chewing gum with xylitol can reduce dental decay.

16. Which of the following statements is true?

a. Xylitol is generally combined with other sweeteners to improve the flavor of a product.
b. Xylitol has as many calories as sucrose but it is better for one's teeth.
c. Xylitol is not currently available.
d. Xylitiol is found in small quantities in fruits and vegetables.

17. The following can be a side effect of xylitol:

a. Heart palpitations
b. Diarrhea
c. Vomiting
d. Cold sores

18. Xylitol has been shown to do which of the following:

a. Reduce S. mutans levels in saliva and plaque.
b. Cause selection of less adherent S. mutans.
c. Remineralize tooth enamel.
d. Influence the transmission of S. mutans from mothers to children.

19. TRUE or FALSE: Studies show that candies and ice pops containing xylitol are significantly less effective in reducing dental decay than xylitol based gum.

a. TRUE
b. FALSE

20. TRUE or FALSE: Chlorhexidine gluconate is effective in killing all oral bacteria.

a. TRUE
b. FALSE

21. Sealants are recommended in all of the following cases EXCEPT:

a. Teeth with incipient occlusal caries.
b. Teeth with pit and fissure caries.
c. Primary teeth only.
d. Teeth of patients who have high caries risk.

22. Sealants are not recommended in which of the following cases:

a. If the tooth cannot be isolated.
b. If a proximal restoration involves a pit and fissure surface.
c. If the life expectancy of the (primary) tooth is short.
d. All of the above.

23. Which of the following statements is true:

a. The sealant technique is becoming more invasive.
b. Studies show that dental caries become arrested under intact sealants.
c. Sealants are not recommended for patients in low socioeconomic conditions.
d. A & B.
e. All of the above.

24. Which of the following are changes that have taken place in the sealant technique:

a. Longer etch time is advocated.
b. Etchants are now less concentrated liquids and gels.
c. Some degree of fissure preparation is now common.
d. B & C.
e. All of the above.

25. Which of the following statements is true?

a. Bonding agents have been shown to have little effect on sealant retention.
b. Flowable composites, glass ionomer cements, and amalgam have all been tried as sealant material.
c. Fissure preparation for sealants should not be done by air abrasion.
d. Only light-cured materials can be used as sealants.

26. Which of the following statements is NOT true?

a. Topical application of fluoride varnishes is becoming less common.
b. Fluoride can be found in household baking soda.
c. Fluoride tablets are less recommended than in the past.
d. Many Americans still do not have fluoride in their drinking water.

27. Which of the following statements are true according to findings of a CDC task force?

a. 75% of eight-year-old American children now have dental sealants.
b. The prevalence of sealants is higher among children at a higher risk for dental decay.
c. The application of sealants reduced tooth decay on occlusal surfaces by 60%.
d. 45% of eight-year-old American children now have dental sealants.

28. According to a study of Puerto Rican babies at high risk for ECC, use of povidone-iodine prevented carious growth for 12 months in:

a. 91% of experimental subjects.
b. 75% of experimental subjects.
c. 24% of control subjects.
d. 83% of control subjects.

29. Which of the following is the typical protocol for chlorhexidine therapy?

a. 0.12% chlorhexidine gluconate for two weeks daily every three months.
b. 0.20% chlorhexidine gluconate for two weeks daily every six months.
c. 0.07% chlorhexidine gluconate for two weeks daily every nine months.
d. 0.45% chlorhexidine gluconate for two weeks daily every thirteen months.

30. What is the appropriate salivary output for the average individual?

a. At least one milliliter per hour.
b. At least five milliliters per minute.
c. At least one milliliter per minute.
d. At least ten milliliters per minute.
e. At least one liter per minute.

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