Quality Resource Guide

Caries Risk Assessment and Management for Adults in a General Practice

Author Acknowledgements

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Educational Objectives

Following this unit of instruction, the learner should be able to:

- 1. Analyze and appraise the risk indicators and risk factors of dental caries.
- 2. Assess patient's caries risk status based on risk indicators and risk factors.
- 3. Discriminate primary, secondary and tertiary preventive treatment in caries management.
- 4. Understand tooth-preserving principles.

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The following commentary highlights fundamental and commonly accepted practices on the subject matter. The information is intended as a general overview and is for educational purposes only. This information does not constitute legal advice, which can only be provided by an attorney.

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Introduction

Dental caries is a very complex disease that affects most individuals during their lifetime. There are several factors, such as diet, biofilm, and absence of saliva among others, that contribute to the establishment and progression of the disease. These are known as "risk factors". If these risk factors are identified early and risk appropriate management is implemented, dental caries lesions may be prevented. Although caries preventive efforts have historically focused on children, there are a myriad of factors that affect adults, placing them at higher caries risk. Identifying these risk factors and determining an adequate management protocol for each patient are key to a successful outcome.

Dental caries treatment has traditionally consisted of restoration of existing caries lesions and placing non-cavitated lesions on "watch" (periodic assessment). Modern management of dental caries involves:²

- 1. Determining the caries risk status of the patient
- Detecting caries lesions at an earlier stage and assessing their activity status
- Making a diagnosis of whether the disease is currently present
- 4. Establishing a prognosis
- Applying intervention strategies focused on preventing, arresting and possibly reversing the caries process
- 6. Restricting restorative treatment to only when absolutely necessary

A **4D approach** (*Determine* patient's caries risk, *Detect* and assess caries lesions, *Decide* on a personalized treatment plan and *Do* caries management) to personalize caries management with the goal of maintaining health and preserving tooth structure (**Figure 1**), has been proposed by the International Caries Classification and Management System (ICCMSTM).¹⁻⁴

The ICCMS spawned from the need to provide a framework for caries management.

Figure 1

The 4-D Approach to Caries Management (ICCMS)



A committee (The International Caries Detection and Assessment System (ICDAS) Foundation committee), formed in 2002, developed a detailed caries detection process based on evidencebased visual criteria to stage dental caries severity.^{5,6} The process allowed close monitoring of changes in dental caries lesions in a preventiveoriented framework for patient-centered caries management. The maturation of the process resulted in the development of the current ICCMS.³⁻⁶ ICCMS calls for non-cavitated lesions that are deemed active, to not be "watched", but instead, be treated with non-restorative options. The goal is to arrest lesion progression and move the patient to a lower caries risk status.

Correctly identifying risk is paramount to a successful treatment, as restorative treatment is subject to failure, frequently due to caries lesions around restorations.⁷ Thus, identifying risk has two objectives: 1) determine which are the main culprits driving the patient's current caries status and 2) determining the best management approach. Evidence supports that Caries Management by Risk Assessment (CAMBRA) leads to better outcomes.⁸⁻¹²

Caries Risk Assessment

Several caries risk assessment (CRA) instruments have been evaluated, predominantly on children, but some have been more recently assessed in adults.¹³⁻¹⁷

Most CRA instruments have some of these elements present:¹⁸

- Previous caries experience
- Diet
- Fluoride exposure
- Saliva
- Medical history

There are several CRA guidelines/systems available.^{12,13,15,19,20} but given the limited evidence favoring one CRA system over another, the healthcare provider should select the CRA that will best work for their environment.²¹ A brief questionnaire that the patient can complete in the waiting room or be asked by the dental assistant, can gather critical information needed for a CRA. Restrictions due to the COVID-19 pandemic demonstrate the benefits of tele dentistry, which can serve as an alternative to

consultations or in-person visits. Tele dentistry has proved to be beneficial for remote dental screening and can serve as a method to save valuable chair time.²² Practitioners should consider incorporating a formal caries risk assessment in their practice. Several electronic record systems have available CRA modules. There are also several CRA instruments applicable to adults that are available online, either at no-cost or for a fee. Some examples of no-cost sources include:

- The ADA CRA (for those older than 6)
 <<u>https://www.ada.org/-/media/project/ada-organization/ada/ada-org/files/resources/public-programs/give-kids-a-smile/gkascaries_risk_assessment_forms.pdf</u>>
- The AAPD (for those 6 years and older)
 <https://www.aapd.org/media/Policies_Guidelines/BP_CariesRiskAssessment.pdf>
- The Cariogram -Caries Risk Assessment Apps for iOS:
 <<u>https://apps.apple.com/us/app/cariogramdental-caries-risk/id1378035435</u>>

Caries Risk Assessment for Android: <<u>https://play.google.com/store/apps/</u> details?id=com.appbites.cariogram&hl=en_ US&gl=US>

CAMBRA

<<u>https://www.frontiersin.org/articles/10.3389/</u> froh.2021.657518/full>

Caries Detection and Assessment: Evidence indicates that previous caries experience is the only consistently reliable caries indicator.^{23,24} Indicators are the signs of the disease. White spot lesions or initial lesions, cavitated lesions or recent restorations are all considered risk indicators for dental caries.

Early caries detection is essential to properly assess the patient's current and future risk before there is frank evidence of disease. Visual examination of a clean dry surface is necessary to optimize detection.⁵ Surfaces that are covered in biofilm or saliva may appear to be sound and early signs of the disease may be missed (see **Figure 2**).

Figures 2 a & b



First molar covered in saliva and after drying. Note the widening of the fissure and the white opacity at the entrance of the fissure on the distal portion visible once the surface is dried.

Because not all dental caries lesions progress to cavitation,^{25,26} determining caries lesion activity is of utmost importance and closely tied to caries risk. Determining which lesion will progress to

cavitation has been a challenge confirmed only by longitudinal monitoring. However, monitoring of these lesions must go beyond placing noncavitated lesions on "watch". Using visual criteria that categorize lesions beyond "watch" and "cavitated" allows the clinician to detect early changes and adjust management accordingly.²⁷⁻²⁹

Some recent reports suggest that visual examination using a more granular assessment such as with the *International Caries Detection and*

ADA CCS	Sound	Ini	tial	Moderate		Advanced		
ICDAS	0	1	2	3 4		5	6	
Clinical Appearance								
Clinical Presentation	No evidence of visible caries (no or questionable change in enamel translucency)	A carious opacity of discoloration (whi and/or brown cari not consistent wit appearance of sou which show no evi breakdown or und shadowing	or visible te spot lesion ous discoloration) h clinical ind enamel and idence of surface lerlying dentin	A white or brown s localized enamel b without visible der an underlying den obviously originate being evaluated	pot lesion with reakdown, tin exposure, or tin shadow, which d on the surface	A distinct cavity with visible dentin		
Activity		Active: Opaque, whitish or brownish, rough, in plaque stagnation area Inactive: Translucent, smooth, shiny, not in plaque stagnation area			Dentin is soft or leathery on gentle probing			
					•	Dentin is shiny and hard on gentle probing		
Radiographic Appearance	JU.		0	C	2			
Radiographic	No	Radiolucency m	nay extend to	Radiolucency ex	tends into the entin	Radiolucency ex	tends into the	



An active enamel lesion is likely covered in plaque, is chalky white, opaque, with a rough texture compared to adjacent enamel. Adjacent gingival tissue will often be inflamed and bleed upon probing.

Figure 5



Modified Schirmer Tear Strip test. After asking the patient to swallow, place the notched end of the strip on the floor of the mouth on either side of the frenulum and hold it for 3 minutes. A reading of <25 indicates hyposalivation. Readings <25 warrant a volumetric or gravimetric unstimulated salivary flow assessment.

Assessment System (ICDAS)⁶ (see Figure 3) can provide some indication of the probability of a lesion progressing towards cavitation based on their clinical characteristics.^{25,30-38} Data indicates that by identifying lesion severity, lesion progression and the rate of progression can be predicted.²⁵ Clinically identified active lesions (**Figure 4**) are more likely to progress to cavitation.²⁵ Assessment of activity can be a valuable tool to determine treatment decision and prognosis in clinical practice.²⁵ The clinical descriptors of lesion severity and activity which can be used in a busy dental office can be seen in **Figure 3**.³⁹

Some new advances may allow for detection of active lesions chairside at a single appointment. A fluorescent nanoparticle-based rinse⁴⁰ (LumiCare™ GreenMark Biomedical Inc. East Lansing, MI) was introduced to the US market in 2021. The premise of the rinse is that the nanoparticles would penetrate the microporosities of initial (active) enamel lesions and the fluorescence would allow for the detection. Another method approved by the FDA in 2021 is an imaging-based system (CalciViS, Edinburgh, Scotland) which captures the luminescence emitted by photoprotein when it binds to free calcium present in active enamel lesions.⁴¹ These new technologies have the potential to provide a more reliable assessment of caries activity and monitoring of lesion behavior with non-operative caries management.

An e-learning tool is available for training on the ICDAS criteria. <<u>https://www.iccms-web.com/</u> register/>

Saliva Assessment: Saliva assessment is often overlooked by clinicians. Adult patients, especially those taking certain medications can be at increased risk for hyposalivation, which significantly increases caries risk. An unstimulated saliva flow assessment provides the most accurate clinical assessment of saliva volume, but even a screening for clinical signs of hyposalivation,⁴² asking the patient about symptoms or using a screening method such as the modified Schirmer Tear strip test can signal a patient that is hyposalivatory (see **Figure 5**).⁴³

Volumetric or gravimetric assessment of saliva can more precisely determine if the patient suffers from hyposalivation. Unstimulated salivary assessment can be determined chairside by the following protocol:

- Have patient rinse mouth with water and sit quietly for 5 minutes.
- During the five-minute test period, instruct the patient to allow their saliva to pool, emptying into a graduated collection cup whenever they feel the need to swallow.
- Instruct patient not to swallow during the test period and to keep their head tilted down and eyes open. At the end of the five minutes ask the patient to expectorate all saliva remaining in their mouth into the cup/vial. Measure the volume of the saliva in the cup (do not include the foam) and then divide by 5 to calculate salivary flow rate in ml/min.
- Unstimulated saliva: Normal: > 0.25 ml/minute Low: 0.1-0.25 ml/min Very low < 0.1 ml/min

Buffering capacity has also been shown to positively correlate to caries risk.^{43,44} Commercial kits such as the CRT® buffer (Ivoclar Vivadent Inc, Schaan, Liechtenstein), and Saliva-Check BUFFER Kit (GC Corp, Tokyo, Japan) are available to assess salivary buffering capacity.

Biofilm: Dental caries is a biofilm-mediated, diet-modulated disease. Presence of *mutans streptococci* and *lactobaccili* in the biofilm have been investigated for decades as the drivers for dental caries. It is now known that over 700 bacterial species are present in dental biofilm and that diet is the driver of the microbiome profile.⁴⁵⁻⁴⁸ In health, the microbiome in the oral biofilm is in symbiosis. When the biofilm is frequently exposed to fermentable carbohydrates, there is a change in both the bacterial profile, and bacterial activity, leading to a dysbiosis and, in time, dental caries lesions develop.⁴⁶

Methods focused on quantifying cariogenic bacteria have not been able to demonstrate a significant correlation to caries risk at individual level. Assessment of biofilm should be considered only to help drive caries management, and not for risk assessment. For example, the practitioner should keep in mind that sticky biofilm is usually associated with a diet high in sugar content, therefore, dietary guidance may be recommended. White-spot or initial lesions covered in biofilm are likely to be active, therefore patients will likely benefit from additional fluoride exposure. Specific assessments of biofilm (for example the CariScreen Testing Meter [CariFree Pharmaceuticals, Albany, OR], which measures ATP to determine bacterial load; OraRisk® Caries [OralDNA® Labs Inc, Eden Prairie, MN], which measures 3 types of harmful bacteria; and Salivary Testing Instrument SillHa [ARKRAY Inc, Kyoto, Japan], which measures cariogenic bacteria, acidity, buffer capacity, blood, leukocyte, protein, and ammonia) may be helpful to motivate patients to improve their oral hygiene.

Dietary Assessment: Diet's role in dental caries is irrefutable. This underscores the importance of assessing a patient's diet. A brief assessment of the diet with the goal of identifying the frequency and type of fermentable carbohydrates exposure is usually enough to determine the main dietary culprits. Focus should be on patterns of in-between meals consumption of fermentable carbohydrates and sipping of any beverage containing sugar. There is some emerging evidence that suggests a simple online learning module can improve hygienists' confidence in dietary provision and have a positive impact on patient behavior change.⁴⁹



When risk factors outweigh protective factors the risk increases (Modified from Featherstone *et al*, 2004).

Protective Factors: Presence of protective factors must also be assessed. Caries is a disease of imbalance.^{50,51} If the risk factors outweigh the protective factors, risk increases. Likewise, protective factors such as fluoride can counteract risk factors. (see **Figure 6**)

Once risk is identified, management geared to the specific risk factors should be implemented. Most caries risk assessment guidelines or systems will place patients at 3 or 4 risk levels: low risk, moderate risk, high risk and extreme risk depending on the current level of caries activity and the risk factors present. Some factors, such as hyposalivation will place most patients at an increased risk. For example, a patient with hyposalivation, a cariogenic diet and active lesions will be at high or extreme risk.

A personalized caries management plan will encompass:

- 1. A Primary Preventive Care Plan, aimed at preventing new lesions.⁵²⁻⁵⁴
- A Secondary Preventive Care Plan, focused on non-operative care of existing lesions.⁵²⁻⁵⁴
- 3. A Tertiary Preventive Care Plan, focused on tooth-preserving restoration of existing lesions.^{1,2,52,53}

Figure 7

Likelihood of Future Caries Development		Current Caries Status at Examination						
		No active lesions	Initial-stage active lesions	Moderate or extensive active lesions				
Patient	Low Risk	Low	Moderate	Moderate				
Caries	Moderate Risk	Low	Moderate	High				
Risk Level	High Risk	Moderate	High	High				
Likelihood of future caries development (Modified from Ismail et al. 2015)								

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The 4-D approach recommended by ICCMS assesses the likelihood that the patient will have new lesions or progression based on their current caries status and caries risk. Although several caries management approaches have significant evidence supporting their use with children, clinicians must be aware that there is very limited evidence of their effectiveness in adults.^{38,55-59}

Prognosis of Future Caries Development

The ICCMS has developed a method to assess a patient's caries risk and presence of caries lesions to project future caries development (see **Figure 7**).

Primary Preventive Care

Primary preventive care should be recommended to all patients.

Fluoride: Fluoridated toothpaste with at least 1000ppm fluoride prevents caries compared to non-fluoridated toothpaste.60 Fluoride works by slowing down demineralization by coprecipitating calcium and phosphate ions that dissolve and by enhancing the precipitation of fluoridated apatite above the critical pH.61 All patients ideally should be exposed to at least a >1000 ppm F⁻ fluoridated toothpaste 2x per day.² For low-risk patients with no existing active lesions, this Fexposure and professional motivation to continue on a healthy path are recommended. Patients at higher caries risk should be exposed to additional fluoride (increased brushing with a fluoridated toothpaste (3x or more per day), fluoride rinses, and fluoride application [varnish or prescription strength fluoridated toothpaste]. Moderate risk patients should receive professional fluoride varnish application 3x per year, while high-risk patients should receive them 4x per year. However, considering the lack of compliance with advice on increasing the number of brushings per day, ICCMS recommends high fluoride toothpaste of ≥1450 ppm F or preferably prescription strength fluoridated toothpaste for routine daily brushing by moderate and high caries risk patients. Low risk patients may use toothpaste with ≥1000 ppm F⁻.

There is strong evidence that these F- application measures can reduce caries incidence between 23-47%.^{56,62} There is some indication that combination of fluoride treatments provide some additional benefits.⁵⁷ Current evidence indicates that fluoride varnishes with the concentration of 5% sodium fluoride are the most efficacious of all topically applied fluoride products.⁶³ The ADA has published guidelines regarding the use of fluoride on children and adults.⁶⁴ <<u>http://jada.ada.org/article/S0002-8177(14)60659-0/fulltext?dgcid=PromoSpots_EBDsite_topical-fluoride></u>

Other measures to address specific risk factors should also be implemented. For example, patients with significant diet challenges should be advised on diet modifications to reduce fermentable carbohydrate exposure.⁶⁵ Motivational interviewing can be an effective tool to promote behavior modification, such as reducing exposure to cariogenic diets, improving oral hygiene and increasing fluoride exposure.⁶⁶

Hyposalivation: Patients that are determined to have hyposalivation (unstimulated saliva is less than 0.1ml/min) should be evaluated for possible intervention. If the cause of hyposalivation is a side-effect of (a)medication(s) the patient's physician may be consulted for possible modification of prescriptions to avoid side-effects impacting

saliva flow. If the saliva glands maintain some of their function (stimulated saliva assessment can determine this) other strategies to improve salivary flow (increased water intake, use of sugar-free candies/mints several times a day, and/or use of xylitol chewing gum) may be tried.

Saliva substitutes or oral moisturizers can improve patient comfort, but there is no evidence that their use reduces caries risk. Prescribing salivary stimulants such as pilocarpine or cevimeline may be very beneficial in patients with functioning salivary glands but who have medicationinduced hyposalivation. Since options to manage hyposalivation are limited, most effort should be placed on decreasing other risk factors (cariogenic diet) and increasing protective factors (fluoride exposure).

Supplements to Fluoride: There is emerging evidence that strategies to maintain a healthy microbiome or to modulate a dysbiotic microbiome can be beneficial.⁶⁷ Probiotics, prebiotics (such as arginine containing products), pH modifiers, Xylitol and Erythritol are strategies that may prove to be helpful to maintain a healthy microbiome.^{68,69} Strategies to modulate a dysbiotic microbiome include antimicrobials, silver, tin, nanoparticles and Smart Bombs – Specifically Target Antimicrobial Peptides (STAMP). There is emerging evidence that shows 1.5% arginine combined with fluoride

Figure 8



Before and after application of SDF. Note the stained dentin after application. After a few days the stain can be observed and the dentin is hard to tactile examination. (Image courtesy of Dr. Epure)

has superior anticaries efficacy to toothpaste containing fluoride alone.^{70,71} However, there is limited evidence supporting these alternative strategies for caries management, and fluoride remains the strategy with the most reliable evidence.^{52,69,72}

Recall intervals for prophylaxis: There is very limited evidence that one specific recall prophylaxis interval (6 months) is appropriate for all individuals.⁷³ Recall intervals should consider patient's caries risk as well as other patient's needs (such as periodontal disease) and adjusted accordingly. High-risk individuals will benefit from shorter intervals (3-4 months) while low risk individuals can be seen at longer intervals.²

Secondary Preventive Care

Secondary preventive care recommendations are for patients that have initial caries lesions not warranting restorative care. Non-cavitated active enamel lesions may benefit from focused brushing with a fluoride toothpaste, topical fluoride application, sealants and infiltrants. Specific measures and effectiveness will vary depending on patient reliability and motivation, brushing efficacy and lesion location.⁷⁴

Accessible surfaces (Smooth surface, root surfaces): An accessible surface can be arrested by focused brushing with a fluoridated toothpaste.⁷⁵ Topical fluoride application in the form of fluoride varnish, gels or rinses has been shown to arrest up to 45% of lesions (in primary teeth).⁷⁶

Silver Diamine Fluoride (SDF) [Ag(NH₃)₂F] (38%) was cleared by the FDA in 2014 to be used in the U.S. as a desensitizer. SDF has been used off-label as a caries arresting medication. Both silver and fluoride play active roles in arresting caries development and treatment of tooth hypersensitivity.⁷⁷ Silver has an antibacterial action that slows demineralization and enhances remineralization. SDF increases dentin microhardness, which can be assessed by tactile examination.⁷⁸ SDF, due to its ease of use, has been recommended to arrest large cavitated lesions, allowing not only conservation of tooth structure, but also delivery of treatment

to groups of patients that either do not have access to traditional restorative care or for whom delivery of the standard treatment is challenging.⁷⁹ There is emerging evidence that 38% SDF in combination with oral health education is likely the most effective method to prevent root caries.⁸⁰⁻⁸³

The main drawback of SDF is that, because of precipitation of silver, carious dentin becomes stained black. Sound dentin and enamel are not stained. There is limited evidence that the application of potassium iodide with SDF reduces staining.⁸⁴

Application of SDF requires removal of the biofilm and application of the product with a microbrush for 3 minutes, followed by either rinsing the area with water or covering the lesion with fluoride varnish or restoration.85 Gingival tissues and lips should be covered with lubricant during application to avoid staining. This approach may give patients who would otherwise be unable to receive treatment a low-cost alternative to arrest caries lesions and preserve their dentition. (see Figure 8) SDF reportedly arrests 65-91% of coronal and root caries.⁸⁶ However, the anti-caries effect of SDF may be reduced over time, therefore 2x per year application is recommended.87,88 Placement of a restoration is indicated for a biofilm retentive lesion.

Occlusal Surfaces: Occlusal surfaces with initial lesions will benefit from placement of sealants.⁸⁹⁻⁹¹ Sealants can reduce occlusal caries up to 51% up to 48 months.⁹² There is also significant evidence showing that a well-sealed lesion will arrest.⁹³⁻⁹⁵ A sealed surface is not at any higher risk than a surface that has never been sealed.

Proximal surfaces: Proximal surfaces with initial (non-cavitated) enamel lesions can benefit from infiltrants (micro-invasive treatments). The surface is etched in this approach with an acid and an unfilled low-viscosity resin is infiltrated into the lesion. Resin infiltration can significantly reduce the odds of lesion progression compared to home or professional non-invasive care.^{89,96-101} The combination with a 5% fluoride varnish application can further improve the odds of lesion arrest.¹⁰⁰

Figure 9





This active lesion was sealed with a temporary restoration. Soft dentin was left on the pulpal floor. Note the change in color of the dentin after removal of the restoration. Dentin was hard to tactile sensation. (Image courtesy of Dr. Maltz)

Tertiary Preventive Care

Tertiary Preventive Care refers to therapy for lesions that operative intervention, removing the least amount of tooth structure required for a successful restoration, to restore function and esthetics.^{2,102,103} Under normal clinical circumstances, in a vital permanent tooth with no symptoms or signs of pulpal pathology, the extent of the dentin caries removal (excavation) is dictated primarily by lesion severity and depth:

- Moderate lesions (lesions not reaching the inner 1/3 of dentin and with no anticipated risk of pulp exposure) should be excavated to a caries-free DEJ and firm dentin.¹⁰³
- Advanced (deep) lesions (lesions reaching the inner 1/3 of dentin and with anticipated risk of pulp exposure) should be excavated to a caries-free DEJ and soft dentin, following a selective caries removal (SCR) protocol.¹⁰³

Selective Caries Excavation (SCR): The SCR protocol is a professionally recognized and accepted tooth-level caries control treatment.7,103-109 It can be used on any restorable tooth with an advanced (deep) caries lesion and having a healthy pulpal and periapical tissues. SCR consists of complete caries removal peripherally to a sound, caries-free DEJ. Caries is removed axially and pulpally to within approximately 1 mm of the pulp (within soft dentin). A glass ionomer (Fuji IX, GC America, Alsip, or IL) temporary restoration or a definitive restoration, is then placed. Growing evidence suggests that temporization followed by re-entry does not contribute to improved clinical outcomes, therefore current research supports the placement of a definitive restoration.7,103,104

Selective caries removal allows a restoration to be placed while avoiding pulpal exposure.^{7,104} Avoiding a pulpal exposure has a great impact on the lifetime prognosis of the tooth and long-term treatment costs. Although the residual dentin thickness cannot be accurately assessed clinically, its preservation is a significant factor in avoiding pulpal distress.

Historically, removal of the bacterial infection has been seen as an essential part of all restorative dental procedures. However even removal of dentin up to hard dentin in deep, advanced caries lesions does not assure that "sterile" dentin remains. Bacteria have been found to be present in all dentinal layers in deep caries lesions. Even when bacteria are present, increasing evidence indicates that when a good seal can be achieved with restorative materials, the lesion will arrest.^{103,110,111} (see **Figure 9**) Therefore, it is not necessary to remove all of the dentin that has been compromised by the caries process. Complete removal of all stained tooth structure in the preparation ultimately leads to significantly larger preparations than the visual-tactile method of evaluating for caries removal, so that approach is no longer recommended.

There are some critical aspects that must be considered when using a SCR protocol:¹¹²

- 1. The tooth should not be symptomatic or have signs of irreversible pulpitis
- A caries free DEJ must be achieved during restoration, as a well-sealed restoration is critical for a successful outcome
- The patient should be clearly informed that some leathery and soft dentin may remain under the restoration with a radiographic presentation that may suggest secondary or residual caries
- 4. The patient must be cognizant of the risk and benefits of this procedure, including the higher risk for endodontic complications.

If the patient is not willing to accept the risks, then alternative treatment such as complete caries removal with vital pulp therapy, endodontic therapy or tooth extraction should be considered.

Part of management is establishing a follow-up or recall interval that is appropriate for the patient's risk. A patient at low risk for caries and having no other concerns (such as periodontal disease or oral cancer risk) can be placed on a 1-year recall interval. A patient at moderate to high-risk interval should be placed at shorter intervals ranging from 2-6 months. A shorter interval allows for more frequent monitoring of lesions that are being treated non-surgically, and re-enforcement of preventive interventions as needed.

Summary

Dental caries is a process that must be managed throughout life. Caries risk assessment should be an ongoing practice facilitating personalization of disease management to the patients' current risk factors and disease status. Although there are a variety of new treatment modalities, fluoride remains the standard of care and other strategies should be used as a supplement to fluoride. Outcomes of care can be improved by selection of the least invasive procedure (fluoride, sealants, infiltration) or selective caries removal aiming to preserve tooth structure and restoring the patient to health.

- Pitts NB, Ekstrand KR, Foundation I. International Caries Detection and Assessment System (ICDAS) and its International Caries Classification and Management System (ICCMS) - methods for staging of the caries process and enabling dentists to manage caries. Community Dent Oral Epidemiol. Feb 2013;41(1):e41-52. doi:10.1111/cdoe.12025
- Ismail AI, Pitts NB, Tellez M, et al. The International Caries Classification and Management System (ICCMS) An Example of a Caries Management Pathway. BMC Oral Health. 2015;15 Suppl 1:S9. doi:10.1186/1472-6831-15-S1-S9
- Martignon S, Pitts NB, Goffin G, et al. CariesCare practice guide: consensus on evidence into practice. Br Dent J. Sep 2019;227(5):353-362. doi:10.1038/ s41415-019-0678-8
- Pitts NB IA, Martignon S, Ekstrand K, Douglas GVA, Longbottom C. ICCMS[™] Guide for Practitioners and Educators. 2014;
- Ismail AI, Sohn W, Tellez M, et al. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. Community Dent Oral Epidemiol. Jun 2007;35(3):170-8. doi:10.1111/j.1600-0528.2007.00347.x
- Pitts N. "ICDAS"--an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dent Health. Sep 2004;21(3):193-8.
- Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE. Operative caries management in adults and children. Cochrane Database Syst Rev. Mar 28 2013;(3):CD003808. doi:10.1002/14651858. CD003808.pub3
- Domejean S, Leger S, Rechmann P, White JM, Featherstone JD. How do dental students determine patients' caries risk level using the Caries Management By Risk Assessment (CAMBRA) system? J Dent Educ. Mar 2015;79(3):278-85.
- Chaffee BW, Featherstone JD. Long-term adoption of caries management by risk assessment among dental students in a university clinic. J Dent Educ. May 2015;79(5):539-47.
- Rechmann P, Chaffee BW, Rechmann BMT, Featherstone JDB. Changes in Caries Risk in a Practice-Based Randomized Controlled Trial. Adv Dent Res. Feb 2018;29(1):15-23. doi:10.1177/0022034517737022
- Featherstone JDB, Chaffee BW. The Evidence for Caries Management by Risk Assessment (CAMBRA(R)). Adv Dent Res. Feb 2018;29(1):9-14. doi:10.1177/0022034517736500
- Featherstone JDB, Crystal YO, Alston P, et al. Evidence-Based Caries Management for All Ages-Practical Guidelines. Review. Frontiers in Oral Health. 2021-April-27 2021;2(14)doi:10.3389/ froh.2021.657518

- Domejean S, White JM, Featherstone JD. Validation of the CDA CAMBRA caries risk assessment--a six-year retrospective study. J Calif Dent Assoc. Oct 2011;39(10):709-15.
- Hansel Petersson G, Akerman S, Isberg PE, Ericson D. Comparison of risk assessment based on clinical judgement and Cariogram in addition to patient perceived treatment need. BMC Oral Health. Jul 07 2016;17(1):13. doi:10.1186/s12903-016-0238-4
- Petersson GH, Twetman S. Caries risk assessment in young adults: a 3 year validation of the Cariogram model. BMC Oral Health. Jan 27 2015;15:17. doi:10.1186/1472-6831-15-17
- Gao X, Di Wu I, Lo EC, Chu CH, Hsu CY, Wong MC. Validity of caries risk assessment programmes in preschool children. J Dent. Sep 2013;41(9):787-95. doi:10.1016/j.jdent.2013.06.005
- Petersson GH, Isberg PE, Twetman S. Caries risk assessment in school children using a reduced Cariogram model without saliva tests. BMC Oral Health. Apr 19 2010;10:5. doi:10.1186/1472-6831-10-5
- Mejare I, Axelsson S, Dahlen G, et al. Caries risk assessment. A systematic review. Acta Odontol Scand. Feb 2014;72(2):81-91. doi:10.3109/0001635 7.2013.822548
- Chaffee BW, Featherstone JDB, Zhan L. Pediatric Caries Risk Assessment as a Predictor of Caries Outcomes. Pediatr Dent. May 15 2017;39(3):219-232. doi:NO_DOI
- Hayes M, Da Mata C, McKenna G, Burke FM, Allen PF. Evaluation of the Cariogram for root caries prediction. J Dent. Jul 2017;62:25-30. doi:10.1016/j. jdent.2017.04.010
- Featherstone JDB, Crystal YO, Alston P, et al. A Comparison of Four Caries Risk Assessment Methods. Review. Frontiers in Oral Health. 2021-April-28 2021;2(15)doi:10.3389/froh.2021.656558
- Ghai S. Teledentistry during COVID-19 pandemic. Diabetes Metab Syndr. Sep - Oct 2020;14(5):933-935. doi:10.1016/j.dsx.2020.06.029
- Beck JD, Weintraub JA, Disney JA, et al. University of North Carolina Caries Risk Assessment Study: comparisons of high risk prediction, any risk prediction, and any risk etiologic models. Community Dent Oral Epidemiol. Dec 1992;20(6):313-21.
- Disney JA, Graves RC, Stamm JW, Bohannan HM, Abernathy JR. The University of North Carolina Caries Risk Assessment Study. II. Baseline caries prevalence. J Public Health Dent. Spring 1990;50(3):178-85.
- Ferreira Zandona A, Santiago E, Eckert GJ, et al. The natural history of dental caries lesions: a 4-year observational study. J Dent Res. Sep 2012;91(9):841-6. doi:10.1177/0022034512455030
- Backer DO. The clinical testing of agents for the prevention of dental caries. Adv Fluorine Res. 1966;4:1-2.

- Zandona AF, Zero DT. Diagnostic tools for early caries detection. J Am Dent Assoc. Dec 2006;137(12):1675-84; guiz 1730.
- Machiulskiene V, Campus G, Carvalho JC, et al. Terminology of Dental Caries and Dental Caries Management: Consensus Report of a Workshop Organized by ORCA and Cariology Research Group of IADR. Caries Res. 2020;54(1):7-14. doi:10.1159/000503309
- Schwendicke F, Splieth C, Breschi L, et al. When to intervene in the caries process? An expert Delphi consensus statement. Clin Oral Investig. Oct 2019;23(10):3691-3703. doi:10.1007/s00784-019-03058-w
- Burt BA, Kolker JL, Sandretto AM, Yuan Y, Sohn W, Ismail AI. Dietary patterns related to caries in a low-income adult population.[see comment]. Caries Research. 2006;40(6):473-80.
- Cook SL, Martinez-Mier EA, Dean JA, et al. Dental caries experience and association to risk indicators of remote rural populations. International Journal of Paediatric Dentistry. 2008;18(4):275-83.
- Ekstrand KR, Martignon S, Ricketts DJ, Qvist V. Detection and activity assessment of primary coronal caries lesions: a methodologic study. Operative Dentistry. 2007;32(3):225-35.
- Finlayson TL, Siefert K, Ismail AI, Sohn W. Psychosocial factors and early childhood caries among low-income African-American children in Detroit. Community Dentistry & Oral Epidemiology. 2007;35(6):439-48.
- Ismail AI, Sohn W, Tellez M, et al. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. Community Dentistry & Oral Epidemiology. 2007;35(3):170-8.
- Ismail AI, Sohn W, Tellez M, Willem JM, Betz J, Lepkowski J. Risk indicators for dental caries using the International Caries Detection and Assessment System (ICDAS). Community Dentistry & Oral Epidemiology. 2008;36(1):55-68.
- Jablonski-Momeni A, Stachniss V, Ricketts DN, Heinzel-Gutenbrunner M, Pieper K. Reproducibility and accuracy of the ICDAS-II for detection of occlusal caries in vitro. Caries Research. 2008;42(2):79-87.
- Varma S, Banerjee A, Bartlett D. An in vivo investigation of associations between saliva properties, caries prevalence and potential lesion activity in an adult UK population. Journal of Dentistry. 2008;36(4):294-9.
- Ekstrand KR, Gimenez T, Ferreira FR, Mendes FM, Braga MM. The International Caries Detection and Assessment System - ICDAS: A Systematic Review. Caries Res. 2018;52(5):406-419. doi:10.1159/000486429

- Young DA, Novy BB, Zeller GG, et al. The American Dental Association Caries Classification System for clinical practice: a report of the American Dental Association Council on Scientific Affairs. J Am Dent Assoc. Feb 2015;146(2):79-86. doi:10.1016/j. adaj.2014.11.018
- Jones NA, Chang SR, Troske WJ, Clarkson BH, Lahann J. Nanoparticle-Based Targeting and Detection of Microcavities. Adv Healthc Mater. Jan 2017;6(1)doi:10.1002/adhm.201600883
- Pitts N, Shanks N, Longbottom C, Willins M, Vernon B. Clinical validation of a novel bioluminescence imaging technology for aiding the assessment of carious lesion activity status. Clinical and Experimental Dental Research. 2021;7(5):772-785. doi:https://doi.org/10.1002/cre2.400
- Plemons JM, Al-Hashimi I, Marek CL, American Dental Association Council on Scientific A. Managing xerostomia and salivary gland hypofunction: executive summary of a report from the American Dental Association Council on Scientific Affairs. J Am Dent Assoc. Aug 2014;145(8):867-73. doi:10.14219/jada.2014.44
- Dyasanoor S, Saddu SC. Association of Xerostomia and Assessment of Salivary Flow Using Modified Schirmer Test among Smokers and Healthy Individuals: A Preliminutesary Study. J Clin Diagn Res. Jan 2014;8(1):211-3. doi:10.7860/ JCDR/2014/6650.3846
- Voelker MA, Simmer-Beck M, Cole M, Keeven E, Tira D. Preliminary findings on the correlation of saliva pH, buffering capacity, flow, Consistency and Streptococcus mutans in relation to cigarette smoking. J Dent Hyg. Feb 2013;87(1):30-7.
- Takahashi N, Nyvad B. Ecological Hypothesis of Dentin and Root Caries. Caries Res. 2016;50(4):422-31. doi:10.1159/000447309
- Nyvad B, Crielaard W, Mira A, Takahashi N, Beighton D. Dental caries from a molecular microbiological perspective. Caries Res. 2013;47(2):89-102. doi:10.1159/000345367
- Takahashi N, Nyvad B. The role of bacteria in the caries process: ecological perspectives. J Dent Res. Mar 2011;90(3):294-303. doi:10.1177/0022034510379602
- Nyvad B, Fejerskov O. Active root surface caries converted into inactive caries as a response to oral hygiene. Scand J Dent Res. Jun 1986;94(3):281-4.
- Hayes MJ, Cheng B, Musolino R, Rogers AA. Dietary analysis and nutritional counselling for caries prevention in dental practise: a pilot study. Aust Dent J. Dec 2017;62(4):485-492. doi:10.1111/ adj.12524
- Featherstone JD. Caries prevention and reversal based on the caries balance. Pediatr Dent. Mar-Apr 2006;28(2):128-32; discussion 192-8.

- Featherstone JD. The caries balance: the basis for caries management by risk assessment. Oral Health Prev Dent. 2004;2 Suppl 1:259-64.
- Fontana M, Gonzalez-Cabezas C. Evidence-Based Dentistry Caries Risk Assessment and Disease Management. Dent Clin North Am. Jan 2019;63(1):119-128. doi:10.1016/j.cden.2018.08.007
- Fontana M. Nonrestorative Management of Cavitated and Noncavitated Caries Lesions. Dent Clin North Am. Oct 2019;63(4):695-703. doi:10.1016/j.cden.2019.06.001
- Yu OY, Lam WY, Wong AW, Duangthip D, Chu CH. Nonrestorative Management of Dental Caries. Dent J (Basel). Oct 18 2021;9(10)doi:10.3390/dj9100121
- Marinho VC, Chong LY, Worthington HV, Walsh T. Fluoride mouthrinses for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. Jul 29 2016;7:CD002284. doi:10.1002/14651858.CD002284.pub2
- Marinho VC. Evidence-based effectiveness of topical fluorides. Adv Dent Res. Jul 01 2008;20(1):3-7. doi:10.1177/154407370802000102
- Marinho VC, Higgins JP, Sheiham A, Logan S. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. 2004;(1):CD002781. doi:10.1002/14651858. CD002781.pub2
- Featherstone JD, Domejean-Orliaguet S, Jenson L, Wolff M, Young DA. Caries risk assessment in practice for age 6 through adult. J Calif Dent Assoc. Oct 2007;35(10):703-7, 710-3.
- Beltran EO, Guiu L, Zarta OL, Pitts NB, Martignon S. Caries classification and management in the context of the CariesCare International (CCI) consensus: a clinical case study. Br Dent J. Sep 2019;227(5):363-366. doi:10.1038/s41415-019-0680-1
- Walsh T, Worthington HV, Glenny AM, Marinho VC, Jeroncic A. Fluoride toothpastes of different concentrations for preventing dental caries. Cochrane Database Syst Rev. Mar 4 2019;3:CD007868. doi:10.1002/14651858.CD007868.pub3
- 61. Ten Cate JM, Buzalaf MAR. Fluoride Mode of Action: Once There Was an Observant Dentist. J Dent Res. Jul 2019;98(7):725-730. doi:10.1177/0022034519831604
- Marinho VC. Cochrane reviews of randomized trials of fluoride therapies for preventing dental caries. Eur Arch Paediatr Dent. Sep 2009;10(3):183-91.
- Marinho VC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. Jul 11 2013;(7):CD002279. doi:10.1002/14651858.CD002279.pub2

- Weyant RJ, Tracy SL, Anselmo TT, et al. Topical fluoride for caries prevention: executive summary of the updated clinical recommendations and supporting systematic review. J Am Dent Assoc. Nov 2013;144(11):1279-91.
- Moynihan PJ, Kelly SA. Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines. J Dent Res. Jan 2014;93(1):8-18. doi:10.1177/0022034513508954
- Yevlahova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. Aust Dent J. Sep 2009;54(3):190-7. doi:10.1111/j.1834-7819.2009.01118.x
- Nascimento MM, Zaura E, Mira A, Takahashi N, Ten Cate JM. Second Era of OMICS in Caries Research: Moving Past the Phase of Disillusionment. J Dent Res. Jul 2017;96(7):733-740. doi:10.1177/0022034517701902
- Chapple IL, Bouchard P, Cagetti MG, et al. Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. J Clin Periodontol. Mar 2017;44 Suppl 18:S39-S51. doi:10.1111/jcpe.12685
- Gruner D, Paris S, Schwendicke F. Probiotics for managing caries and periodontitis: Systematic review and meta-analysis. J Dent. May 2016;48:16-25. doi:10.1016/j.jdent.2016.03.002
- Wolff MS, Schenkel AB. The Anticaries Efficacy of a 1.5% Arginine and Fluoride Toothpaste. Adv Dent Res. Feb 2018;29(1):93-97. doi:10.1177/0022034517735298
- Bijle MN, Ekambaram M, Yiu CKY. A Scoping Review on Arginine in Caries Prevention. J Evid Based Dent Pract. Sep 2020;20(3):101470. doi:10.1016/j.jebdp.2020.101470
- Fontana M. Enhancing Fluoride: Clinical Human Studies of Alternatives or Boosters for Caries Management. Caries Res. 2016;50 Suppl 1:22-37. doi:10.1159/000439059
- Fee PA, Riley P, Worthington HV, Clarkson JE, Boyers D, Beirne PV. Recall intervals for oral health in primary care patients. Cochrane Database Syst Rev. Oct 14 2020;10:CD004346. doi:10.1002/14651858.CD004346.pub5
- Stahl J, Zandona AF. Rationale and protocol for the treatment of non-cavitated smooth surface carious lesions. Gen Dent. Mar-Apr 2007;55(2):105-11.
- Nyvad B, ten Cate JM, Fejerskov O. Arrest of root surface caries in situ. J Dent Res. Dec 1997;76(12):1845-53. doi:10.1177/00220345970760 120701
- Keller MK, Klausen BJ, Twetman S. Fluoride varnish or fluoride mouth rinse? A comparative study of two school-based programs. Community Dent Health. Mar 2016;33(1):23-6.

- Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet". J Dent Res. Feb 2009;88(2):116-25. doi:10.1177/0022034508329406
- Prakash M, Kang YH, Jain S, Zandona AF. In-vitro Assessment of Silver Diamine Fluoride Effect on Natural Carious Dentin Microhardness. Original Research. Frontiers in Dental Medicine. 2021-December-17 2021;2doi:10.3389/ fdmed.2021.811308
- Contreras V, Toro MJ, Elias-Boneta AR, Encarnacion-Burgos A. Effectiveness of silver diamine fluoride in caries prevention and arrest: a systematic literature review. Gen Dent. May-Jun 2017;65(3):22-29.
- Hendre AD, Taylor GW, Chavez EM, Hyde S. A systematic review of silver diamine fluoride: Effectiveness and application in older adults. Gerodontology. Aug 15 2017;doi:10.1111/ger.12294
- Zhang J, Sardana D, Li KY, Leung KCM, Lo ECM. Topical Fluoride to Prevent Root Caries: Systematic Review with Network Metaanalysis. J Dent Res. May 2020;99(5):506-513. doi:10.1177/0022034520906384
- Grandjean ML, Maccarone NR, McKenna G, Muller F, Srinivasan M. Silver Diamine Fluoride (SDF) in the management of root caries in elders: a systematic review and meta-analysis. Swiss Dent J. May 10 2021;131(5):417-424.
- Castelo R, Attik N, Catirse A, Pradelle-Plasse N, Tirapelli C, Grosgogeat B. Is there a preferable management for root caries in middle-aged and older adults? A systematic review. Br Dent J. May 27 2021;doi:10.1038/s41415-021-3003-2
- Zhao IS, Mei ML, Burrow MF, Lo EC, Chu CH. Effect of Silver Diamine Fluoride and Potassium lodide Treatment on Secondary Caries Prevention and Tooth Discolouration in Cervical Glass Ionomer Cement Restoration. Int J Mol Sci. Feb 06 2017;18(2) doi:10.3390/ijms18020340
- Young DA, Quock RL, Horst J, et al. Clinical Instructions for Using Silver Diamine Fluoride (SDF) in Dental Caries Management. Compend Contin Educ Dent. Jun 2021;42(6):e5-e9.
- Seifo N, Cassie H, Radford JR, Innes NPT. Silver diamine fluoride for managing carious lesions: an umbrella review. BMC Oral Health. Jul 12 2019;19(1):145. doi:10.1186/s12903-019-0830-5
- Fung MHT, Duangthip D, Wong MCM, Lo ECM, Chu CH. Randomized Clinical Trial of 12% and 38% Silver Diamine Fluoride Treatment. J Dent Res. Aug 01 2017:22034517728496. doi:10.1177/0022034517728496
- Slayton RL, Urquhart O, Araujo MWB, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. J Am Dent Assoc. Oct 2018;149(10):837-849 e19. doi:10.1016/j.adaj.2018.07.002

- Bakhshandeh A, Ekstrand K. Infiltration and sealing versus fluoride treatment of occlusal caries lesions in primary molar teeth. 2-3 years results. Int J Paediatr Dent. Jan 2015;25(1):43-50. doi:10.1111/ ipd.12096
- Condo R, Cioffi A, Riccio A, Totino M, Condo SG, Cerroni L. Sealants in dentistry: a systematic review of the literature. Oral Implantol (Rome). Mar 2013;6(3):67-74.
- Khouja T, Smith KJ. Cost-effectiveness analysis of two caries prevention methods in the first permanent molar in children. J Public Health Dent. Aug 18 2017;doi:10.1111/jphd.12246
- Wright JT, Crall JJ, Fontana M, et al. Evidence-based clinical practice guideline for the use of pit-andfissure sealants: A report of the American Dental Association and the American Academy of Pediatric Dentistry. J Am Dent Assoc. Aug 2016;147(8):672-682 e12. doi:10.1016/j.adaj.2016.06.001
- Fontana M, Platt JA, Eckert GJ, et al. Monitoring of sound and carious surfaces under sealants over 44 months. J Dent Res. Nov 2014;93(11):1070-5. doi:10.1177/0022034514551753
- Evidence-based Clinical Practice Guideline for the Use of Pit-and-Fissure Sealants. Pediatr Dent. Oct 15 2016;38(5):120-136.
- Alves LS, Giongo F, Mua B, et al. A randomized clinical trial on the sealing of occlusal carious lesions: 3-4-year results. Braz Oral Res. Jun 05 2017;31:e44. doi:10.1590/1807-3107BOR-2017. vol31.0044
- Dorri M, Dunne SM, Walsh T, Schwendicke F. Microinvasive interventions for managing proximal dental decay in primary and permanent teeth. Cochrane Database Syst Rev. Nov 05 2015;(11):CD010431. doi:10.1002/14651858.CD010431.pub2
- Arthur RA, Zenkner JE, d'Ornellas Pereira Junior JC, Correia RT, Alves LS, Maltz M. Proximal carious lesions infiltration-a 3-year follow-up study of a randomized controlled clinical trial. Clin Oral Investig. May 30 2017;doi:10.1007/s00784-017-2135-x
- Chatzimarkou S, Koletsi D, Kavvadia K. The effect of resin infiltration on proximal caries lesions in primary and permanent teeth. A systematic review and meta-analysis of clinical trials. J Dent. Oct 2018;77:8-17. doi:10.1016/j.jdent.2018.08.004
- Meyer-Lueckel H, Wardius A, Krois J, et al. Proximal caries infiltration - Pragmatic RCT with 4 years of follow-up. J Dent. Aug 2021;111:103733. doi:10.1016/j.jdent.2021.103733

- Urquhart O, Tampi MP, Pilcher L, et al. Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis. J Dent Res. Jan 2019;98(1):14-26. doi:10.1177/0022034518800014
- Gelani R, Zandona A, Lippert F, Kamocka M, Eckert G. In Vitro Progression of Artificial White Spot Lesions Sealed With an Infiltrant Resin. Operative Dentistry. 2014;39(5):481-488. doi:10.2341/13-202-I
- 102. Innes NP, Frencken JE, Bjorndal L, et al. Managing Carious Lesions: Consensus Recommendations on Terminology. Adv Dent Res. May 2016;28(2):49-57. doi:10.1177/0022034516639276
- Schwendicke F, Frencken JE, Bjorndal L, et al. Managing Carious Lesions: Consensus Recommendations on Carious Tissue Removal. Adv Dent Res. May 2016;28(2):58-67. doi:10.1177/0022034516639271
- 104. Ricketts DN, Kidd EA, Innes N, Clarkson J. Complete or ultraconservative removal of decayed tissue in unfilled teeth. Cochrane Database Syst Rev. 2006;(3):CD003808. doi:10.1002/14651858. CD003808.pub2
- Carvalho JC, Dige I, Machiulskiene V, et al. Occlusal Caries: Biological Approach for Its Diagnosis and Management. Caries Res. 2016;50(6):527-542. doi:10.1159/000448662
- Maltz M, Jardim JJ, Mestrinho HD, et al. Partial removal of carious dentine: a multicenter randomized controlled trial and 18-month follow-up results. Caries Res. 2013;47(2):103-9. doi:10.1159/000344013
- 107. Maltz M, Alves LS. Incomplete caries removal significantly reduces the risk of pulp exposure and post-operative pulpal symptoms. J Evid Based Dent Pract. Sep 2013;13(3):120-2. doi:10.1016/j. jebdp.2013.07.014
- Schwendicke F, Walsh T, Lamont T, et al. Interventions for treating cavitated or dentine carious lesions. Cochrane Database Syst Rev. Jul 19 2021;7:CD013039. doi:10.1002/14651858. CD013039.pub2
- 109. Barros MMAF, De Queiroz Rodrigues MI, Muniz FWMG, Rodrigues LKA. Selective, stepwise, or nonselective removal of carious tissue: which technique offers lower risk for the treatment of dental caries in permanent teeth? A systematic review and meta-analysis. Clinical Oral Investigations. 2020/02/01 2020;24(2):521-532. doi:10.1007/ s00784-019-03114-5
- Maltz M, Henz SL, de Oliveira EF, Jardim JJ. Conventional caries removal and sealed caries in permanent teeth: a microbiological evaluation. J Dent. Sep 2012;40(9):776-82. doi:10.1016/j. jdent.2012.05.011
- 111. Maltz M, Garcia R, Jardim JJ, et al. Randomized trial of partial vs. stepwise caries removal: 3-year follow-up. J Dent Res. Nov 2012;91(11):1026-31. doi:10.1177/0022034512460403
- 112. Ferreira Zandona AG. Surgical Management of Caries Lesions: Selective Removal of Carious Tissues. Dent Clin North Am. Oct 2019;63(4):705-713. doi:10.1016/j.cden.2019.07.001

POST-TEST

Internet Users: This page is intended to assist you in fast and accurate testing when completing the "Online Exam." We suggest reviewing the questions and then circling your answers on this page prior to completing the online exam.

(1.0 CE Credit Contact Hour) Please circle the correct answer. 70% equals passing grade.

1. Which of the following is the most reliable indicator of future caries risk?

- a. Recent fluoride exposure
- b. Cariogenic diet
- c. Heavy biofilm (plaque) deposit
- d. Previous caries experience
- 2. Which of the following are critical steps when using selective caries excavation?
 - a. The DEJ must be caries free prior to restoration placement.
 - b. All stained dentin must be removed prior to restoration placement.
 - c. Leathery dentin is left at the pulpal wall and may be left at the DEJ after excavation.
 - d. The tooth may be symptomatic or asymptomatic.

3. Which of the following is true regarding silver diamine fluoride?

- a. It has been cleared by the FDA to be used as a caries arresting medication.
- b. It has been cleared by the FDA to be used to treat dentin hypersensitivity.
- c. It will stain sound enamel and dentin when applied.
- d. It should not be used on root caries.

4. When silver diamine fluoride is effective what changes do you expect to see to an active cavitated dentin lesion?

- a. The carious dentin surface becomes light and hard to probing.
- b. The carious dentin surface becomes dark and hard to probing.
- c. The carious dentin surface becomes light and soft to probing.
- d. The carious dentin surface becomes dark and soft to probing.

5. Which of the following is the best approach to active non-cavitated enamel lesion?

- a. Watch
- b. Treat with restorative approaches
- c. Treat with non-restorative approaches
- d. Do nothing

6. Which of the following can significantly increase a patient risk for future caries?

- a. Hyposalivation
- b. Age
- c. Periodontal disease
- d. Smoking

7. Which of the following is true in relation to fluoride?

- a. All patients should be exposed to toothpaste with 1000 ppm of fluoride or more.
- b. Fluoride will reduce caries from 85-100%.
- c. A single annual application of fluoride is adequate to high-risk patients.
- d. There is no benefit to having additional fluoride beyond a fluoridated toothpaste.

8. Which of the following is true in relation to sealants?

- a. They can only be placed on sound occlusal surfaces.
- b. They will reduce only 5% of occlusal caries up to 48 months.
- c. A well-sealed lesion can arrest.
- d. They can be placed on cavitated lesions.
- 9. According to available evidence which of the following should the clinician perform after selective caries excavation?
 - a. Remove the restoration to assure that the lesion has arrested.
 - b. Place a temporary restoration.
 - c. Place a final restoration.
 - d. Place a sealant.
- 10. Which of the following is true when managing deep dentinal lesions?
 - a. There are no inherent risks to selective caries excavation.
 - b. The patient should be aware that selective caries excavation does not eliminate the risk for endodontic complications.
 - c. Complete caries removal with vital pulpal therapy is the only option for treatment.
 - d. Endodontic therapy is the most conservative treatment.

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Evaluation - Caries Risk Assessment and Management for Adults in a General Practice 2nd Edition

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