ACE
Dental Academy of Continuing Education ™

EARN
3 CE
CREDITS

This course was written for dentists, dental hygienists, and dental assistants.

Caries management: When, why, and how

A peer-reviewed article written by Gregori M. Kurtzman, DDS, DADIA, DICOI, DIDIA, FACD, FPFA, MAGD

PUBLICATION DATE:	MAY 2020
EXPIRATION DATE:	APRIL 2023

ENDEAVOR BUSINESS MEDIA

SUPPLEMENT TO ENDEAVOR PUBLICATIONS

EARN
3 CE
CREDITS

Caries management: When, why, and how

ABSTRACT

Restorative dentistry has become increasingly conservative in its treatment of incipient lesions of enamel and dentin. Preservation of native tooth structure improves the longevity of the tooth, and identification at its earliest stages of demineralization allows more conservative intervention. We will discuss methods to treat white-spot lesions to reverse demineralization and prevent involvement of the underlying dentin. Additionally, methods will be discussed for conservative tooth preparation of incipient lesions and better methods for selective tooth removal of affected dentin.

EDUCATIONAL OBJECTIVES

At the conclusion of this educational activity, participants will be able to:

1. Describe how to treat white-spot lesions
2. Identify what treatments can be employed for conservative caries treatment of incipient lesions
3. Describe treatments that may be employed for root exposure

ACE
Dental Academy of Continuing Education ™

Go online to take this course.
DentalAcademyofCE.com
QUICK ACCESS CODE 15437

This continuing education (CE) activity was developed by the PennWell dental group, an operating unit of Endeavor Business Media, with no commercial support.

This course was written for dentists, dental hygienists, and dental assistants, from novice to skilled.

Educational methods: This course is a self-instructional journal and web activity.

Provider disclosure: Endeavor Business Media neither has a leadership position nor a commercial interest in any products or services discussed or shared in this educational activity, nor with the commercial supporter. No manufacturer or third party had any input in the development of the course content.

Requirements for successful completion: To obtain three CE credits for this educational activity, you must pay the required fee, review the material, complete the course evaluation, and obtain a score of at least 70%.

CE planner disclosure: Laura Winfield, Endeavor Business Media dental group CE coordinator, neither has a leadership nor commercial interest with the products or services discussed in this educational activity. Ms. Winfield can be reached at lwinfield@endeavorb2b.com

Educational disclaimer: Completing a single continuing education course does not provide enough information to result in the participant being an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

Image authenticity statement: The images in this educational activity have not been altered.

Scientific integrity statement: Information shared in this CE course is developed from clinical research and represents the most current information available from evidence-based dentistry.

Known benefits and limitations of the data: The information presented in this educational activity is derived from the data and information contained in reference section. The research data is extensive and provides a direct benefit to the patient and improvements in oral health.

Registration: The cost of this CE course is $59 for three CE credits.

Cancellation and refund policy: Any participant who is not 100% satisfied with this course can request a full refund by contacting Endeavor Business Media in writing.

PACE
ACADEMY of GENERAL DENTISTRY
PROGRAM APPROVAL FOR CONTINUING EDUCATION

Endeavor Business Media
Nationally Approved PACE Program Provider for FAGD/MAGD credit. Approval does not imply acceptance by any regulatory authority or AGD endorsement. 11/1/2019 to 10/31/2022. Provider ID# 320452

Endeavor Business Media is designated as an approved PACE program provider by the Academy of General Dentistry (AGD). The formal continuing dental education programs of this program provider are accepted by the AGD for fellowship, mastership, and membership maintenance credit. Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. The current term of approval extends from (11/1/2019) to (10/31/2022) Provider ID# 320452.

AADH

Endeavor/PennWell Corporation is designated as an approved Provider by the American Academy of Dental Hygiene Inc. # AADHPNW (January 1, 2019–December 31, 2020). Approval does not imply acceptance by a state or provincial Board of Dentistry. Licensee should maintain this document in the event of an audit.

ADA CERP® | Continuing Education Recognition Program

Endeavor Business Media is an ADA CERP–recognized provider

ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP does not approve or endorse individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry.

Concerns or complaints about a CE provider may be directed to the provider or to ADA CERP at ada.org/goto/cerp.

ENDEAVOR BUSINESS MEDIA

General dental practice and restorative dentistry is predominantly centered on management of caries of the remaining dentition. *When* caries are identified will determine the treatment indicated to arrest the demineralization process and how to restore the tooth to full function and maintain the dentition. Technology has advanced beyond the explorer to allow identification of incipient lesions of the enamel and dentin, permitting earlier intervention and subsequent preservation of tooth structure. Tooth longevity is correlated with the amount of native tooth structure remaining. The more dentin and enamel that is preserved, the greater the longevity of the tooth.

We will discuss methods of early intervention when chalky areas present on the enamel, indicating the start of enamel demineralization, and segue into methods to preserve tooth structure when incipient lesions are noted that require preparation of the tooth with conservative restorations.

EARLY INTERVENTION

Early intervention is indicated when changes are noted to the tooth surface before cavitation has resulted. Cavitation is defined as microstructural damage to the enamel, exposing the underlying dentin to oral bacteria with subsequent breakdown via acid attack that leads to caries. When an explorer is used to diagnose pit and fissure discoloration, light force should be applied with the tip, as heavier forces may increase the potential for cavitating the area.[1-4]

Initial surface changes will appear as color changes to the enamel in comparison to surrounding tooth, indicating the initiation of demineralization of the tooth structure and is termed an incipient lesion. Typically, when this initial breakdown contacts the dentin below, more direct treatment would be indicated, although early intervention may be applied to root exposure of dentin when structural changes have not initiated to either prevent future breakdown or for treatment of sensitivity.

REMINERALIZATION

When white spots are noted on the smooth surfaces of the teeth or at the pits and fissures without surface breakdown, this is a sign of early decalcification of the enamel surface, an incipient lesion. If allowed to progress, this will require more extensive restorative treatment. When identified and preventive treatment is initiated, these superficial areas can undergo remineralization.

Isolated areas of initial demineralization may be indicative of weaker areas of the enamel, and remineralization therapy may be effective when sensitivity is not present on that area of the tooth. Sensitivity typically indicates deeper penetration of the demineralization extending to the DEJ, and something more extensive may be required to arrest the initial breakdown. This may involve sealing the surface with an adhesive resin to reinforce the enamel and prevent further demineralization, or a conservative preparation to remove the affected enamel and dentin may be required.

TOPICAL REMINERALIZATION HOME THERAPY

When minor enamel demineralization is noted that has resulted in whitening of the enamel compared to the surrounding tooth structure (white-spot lesions or areas associated with the pits and fissures), and an incipient lesion has not been identified, at-home remineralization may be used to prevent advancement that can lead to definitive caries. This also has application to root exposure as a preventive to caries on areas that are not protected by overlying enamel. Fluoride rinses or topical application daily, may be sufficient in some patients to treat these minor initial chalky areas.

Calcium phosphate based remineralization products have shown promising results for noninvasive management of these areas before early carious lesions can occur.[5,6] Application of products containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) may lead to suppression of demineralization and enhancement of remineralization.[7] It is has been demonstrated that the combined application of CPP-ACP with fluoride provides a synergistic effect on enamel remineralization.[8,9] Tooth Mousse Plus (MI Paste Plus; GC America, Alsip, Chicago) combines CPP-ACP and 900 ppm fluoride (CPP-ACPF) to provide a more therapeutic effect than Tooth Mousse (MI Paste), which contains CPP-ACP alone.

Alternatively, a remineralizing water-based cream containing hydroxyapatite, fluoride, and xylitol (Remin Pro, VOCO Dental, Indian Land, SC) is available. The manufacturer claims that the eroded enamel is filled by the hydroxyapatite, the fluoride seals any exposed dentinal tubules, and xylitol acts as an antibacterial agent. This product is suitable for prevention of enamel demineralization, promoting remineralization of enamel subsurface lesions, and management of dentinal hypersensitivity.[10,11]

RESIN INFILTRATION OF ENAMEL SURFACE WHITE SPOTS

When white-spot lesions (WSLs) are noted and penetration has not reached the DEJ and the surface is intact, reinforcement of the decalcified enamel is possible without preparation of the tooth to accommodate a restoration. Resin infiltration is a minimally invasive restorative treatment for white-spot lesions and hypocalcified enamel lesions on the facial/buccal surfaces (figure 1) or incipient enamel lesions interproximally (figure 2). These are associated with subsurface enamel porosities caused by a cyclical imbalance between demineralization and remineralization of the enamel, resulting from poor hygiene and associated plaque and bacteria-derived acids. Over time, remineralization of the outer surface of the tooth decreases the access of calcium and other ions to deeper portions of the enamel, eventually arresting the lesion. During resin infiltration, the acid resistant resin fills in the molecular spots in the enamel that calcium had been removed related to acid attack of the enamel surface making the area more resistant to future demineralization. The benefits to resin infiltration in treating these WSLs are that it is much less invasive, it conserves tooth structure, and it may eliminate sensitivity without the need to remove the spot in preparation for a restoration.

Enamel demineralization and WSLs are subsurface demineralization representing the first stage of caries formation. The etiology of white spots relates to pathogenic bacteria that infiltrate the surface of the enamel, producing organic acids capable of dissolving the calcium and phosphate ions of the dental structure, thus causing lesions.[12] The microporosities within the hypocalcified enamel are filled with either a watery

medium or air. Ambient light that shines on the teeth is deflected and scattered, making the initial carious lesions appear as a clinically visible opacity, especially when desiccated.[13]

The aim of this treatment is to prevent further progression of early carious lesions by occluding pores of the hypocalcified enamel, which acts as a cariogenic acid pathway. A very low viscosity resin, referred to as "infiltrant," acts by occluding those pores by capillary forces.[14] When the pores are filled with the resin infiltrant, the infiltrated WSLs appear to be similar to the surrounding sound enamel.[15] If the pores of the lesion body can be completely occluded with the infiltrant, the progression of WSLs can be prevented and esthetic issues can also be resolved.[16] The infiltration of low-viscosity light-curing resin into the subsurface lesion is an intermediary treatment between preventive and restorative therapy for the arrest of carious lesions, leading to the arrest of caries progression[17] and esthetic improvement.[18] The infiltration of the resin of porous lesion structures could mechanically strengthen the lesion, helping to prevent the formation of caries. It also blocks the further introduction of any nutrition into the porous system. In addition, this method can be used with patients with a known fluoride sensitivity.[19,20] ICON (DMG, Ridgefield Park, NJ) is a resin infiltration product used chairside to force resin into the hypocalcified enamel, thus reinforcing it. This resin infiltration is considered a long-term treatment solution. Research shows stability for at least two years.[21] Resin infiltration is limited to hypocalcification of the enamel but may be used in clinical situations where it has reached the DEJ as long as the enamel surface is intact. Esthetically, WSLs—when infiltrated with resin—will show a better blend with adjacent normal enamel, but the WSLs may not completely disappear visually.[21]

FIGURE 1: Resin infiltration with ICON (DMG) to treat white spots on the facial surfaces of the anterior teeth.

FIGURE 2: Resin infiltration being used to treat incipient lesion on the surface of the interproximal enamel.

CARIES TREATMENT

Restorative treatment today has moved increasingly to conservation of tooth structure, as it has been shown that maintaining native tooth structure increases the long-term survival of the tooth. No artificial material has been developed to date that restores tooth structure to pretreatment strength. As teeth flex under loading (mastication), the stresses are concentrated at the cervical area, so preservation of this area is critical to long-term tooth survival. Additionally, maintenance of coronal tooth structure is important to long-term function, and preserving this should be the goal of treatment. This starts with identification of caries as early as possible and treatment of those lesions while maintaining unaffected tooth structure.

PIT AND FISSURE TREATMENT

Pit and fissure depth and width vary from patient to patient in healthy, noncarious-involved teeth. Shallow pits and fissures are easier for the patient to maintain through home care so that bacteria are not able to initiate incipient lesions as readily. Patients with deep pits and fissures are more prone to incipient lesions since toothbrush bristles are often wider than the pits and fissures, hampering home care and allowing initiation of caries. In primary teeth, 44% of early carious lesions are found in the pits and fissures of molars.[22] Within the adult population, initial caries in posterior teeth are also found predominantly in the pits and fissures. We see less of this in adults than in children due to improved home care and diets lower in carbohydrates if the patient makes it to adulthood with posterior teeth unaffected or restored.[43]

Sealants have proven to greatly improve caries prevention in vulnerable pits and fissures.[23-25] These are routinely recommended in children, but adults can benefit from these conservative restorations when incipient lesions are identified in the pits and fissures. Depending on the anatomy of the pits and fissures, surface treatment may vary from acid etching the enamel, microetching with an air abrasion unit, or treatment with an Er:YAG laser to improve bondability to the enamel. These options will be operator-dependent related to what is available in the practice. Traditional acid etching may be challenging in children related to taste of the etching gel and use of air abrasion or laser etching may make patient management easier in that patient population. Although, air abrasion cannot confine the powder to only the surface of the tooth being treated, it has a neutral taste and may be less objectionable to the patient. The benefit of the Er:YAG laser is that it eliminates issues with etch gel taste and application time, provides powder dispersement orally, and allows less time between initiation of sealant treatment and placement of the resin on the tooth. Deeper pits and fissures or those with definitive caries require minimal preparation to access and remove caries prior to restoring those areas with an adhesive restorative material such as a flowable resin.

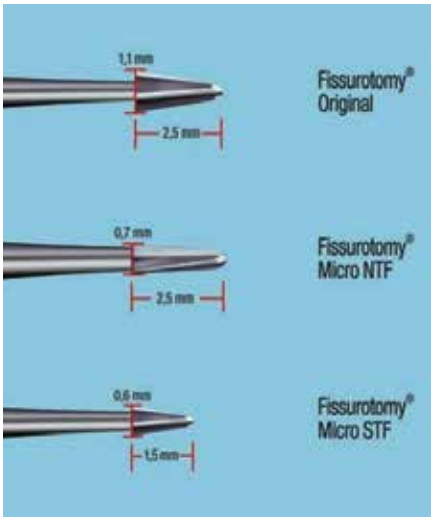

FIGURE 3: Fissurotomy burs in three sizes available for conservative preparation of pits and fissures to treat incipient lesions.

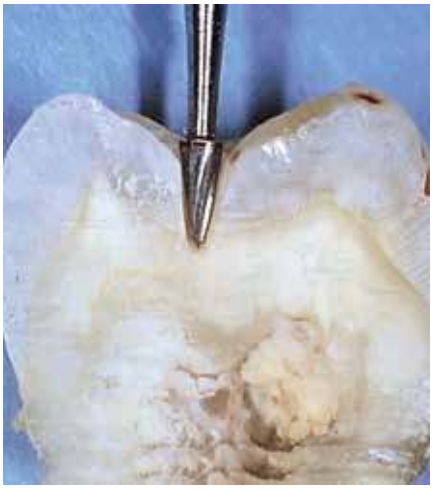

FIGURE 4: Due to its microdimensions, the fissurotomy bur allows preparation of the pits and fissures without sacrificing adjacent tooth structure that would occur with traditional burs.

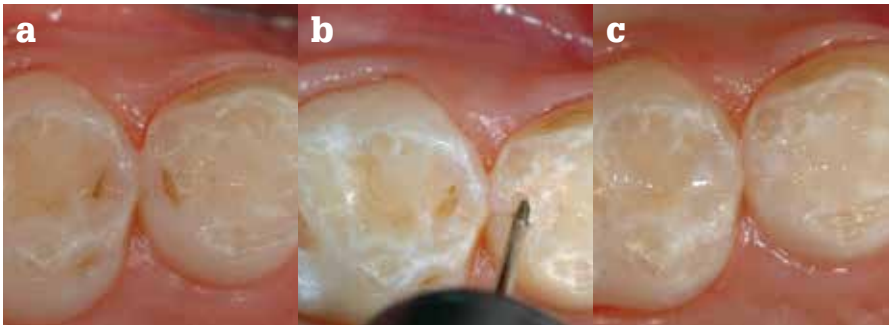

FIGURE 5: (a) Incipient caries identified in the stained pits of the deciduous molars; (b) conservative preparation of pits and fissures is achievable with the fissurotomy bur; (c) and a conservative bonded-resin restoration placed and finished

FIGURE 6: The fissurotomy bur can be utilized to create micromechanical retention in the preparation when treating cervical caries to resist the potential of restoration pop-out during function.

FIGURE 7: Polymer Smartburs in various sizes for caries removal on dentin

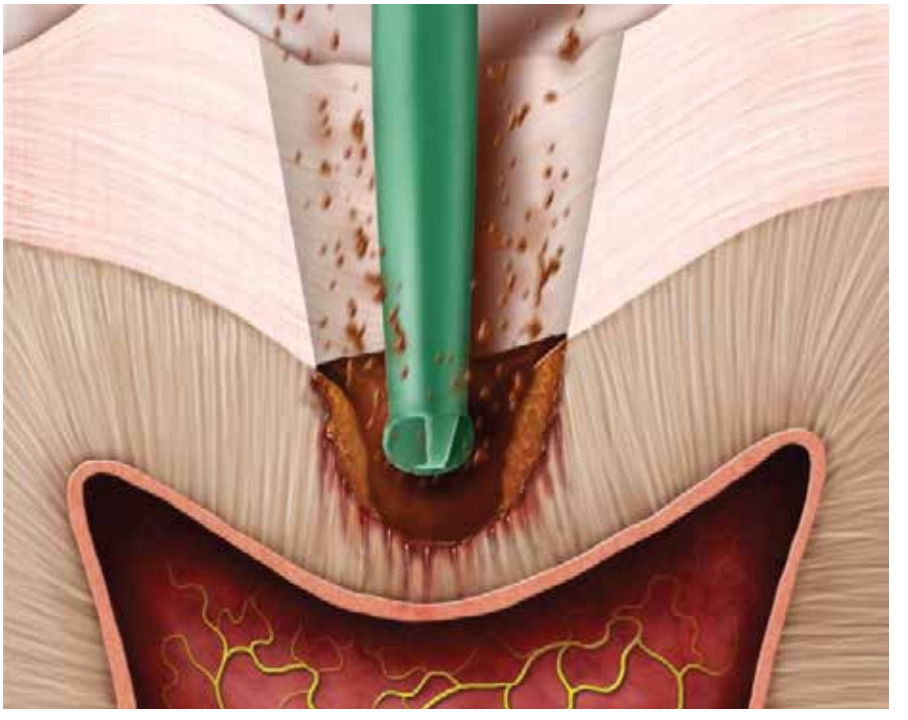

FIGURE 8: The polymer Smartbur has no cutting ability on enamel and is selective in cutting for affected dentin, providing a safety factor when selectively removing caries, thus lessening the potential for pulpal exposure compared to use of a stainless steel or carbide bur.

FIGURE 9: (a) Cervical caries noted requiring restorations; (b) following access to carious dentin, the Smartbur is used to selectively remove affected dentin; (c) while preserving unaffected dentin to follow conservative tooth preparation goals

FISSUROTOMY BURS

Fissurotomy burs (Smartbur, SS White) are high-speed, friction-fit carbide burs of very narrow width and a pointed shape designed to conservatively access pits and fissures (figure 3). These allow access to the areas affected without sacrificing adjacent tooth structure that would occur with a traditional carbide bur (figure 4). When a discolored pit or fissure is identified as an incipient lesion, either with an explorer or caries detection device (figure 5, left), the fissurotomy bur is used to prepare only the affected spot (figure 5, middle) and preserve healthy adjacent tooth structure for a conservative restoration. A flowable resin would then be placed versus a traditional sealant resin, as the flowable resins are filled and will offer better wear resistance and, hence, longer survival potential to the restoration (figure 5, right). Fissurotomy burs are also well suited for creation of micromechanical retention to aid in maintenance of the adhesive restoration when restoring cervical breakdown (figure 6).

SMARTBURS

Selective removal of affected dentin can be challenging with a carbide bur or diamond as it is difficult, if not impossible, to use tactile feel to remove affected dentin while saving the unaffected tooth structure. The key is a removal instrument that is harder than the affected dentin but softer than unaffected dentin, which will selectively remove tooth structure while preserving undamaged structure. With this goal in mind, a polymer bur was developed (Smartbur, SS White) that is used with the slow-speed handpiece (figure 7).[26] Following removal of affected enamel and access to the carious dentin below, the majority of affected dentin is removed with traditional burs or diamonds, leaving some decay at the base of the preparation. These polymer burs limit potential for inadvertent pulpal exposure during deep caries excavation (figure 8). The Smartbur is then used on the deeper areas to remove the affected dentin while preserving as much tooth structure as possible (figure 9). The burs are single-use and wear quickly when contacting unaffected dentin. They have no effect on enamel and are designed to be used only on dentin. An

added benefit of these burs is a decrease in pulp exposure when excavating deep caries when compared to use of a carbide bur or diamond.

OZONE TREATMENT

Ozone has been shown to cause the inactivation of bacteria, viruses, fungi, yeast, and protozoa. This occurs as it disrupts the integrity of the bacterial cell walls by oxidation of their phospholipids and lipoproteins. Ozone, at low concentrations of 0.1 ppm, is sufficient to inactivate bacterial cells including their spores.[27] In fungi, it inhibits cell growth at certain stages, with budding cells being the most sensitive.[28] With regard to viruses, ozone damages the viral capsid and upsets the reproductive cycle by disrupting virus-to-cell contact with peroxidation.[29] Ozone oxidizes pyruvic acid produced by cariogenic bacteria into acetate and carbon dioxide, removing the bacteria's effects on tooth structure.[30] Reversal and arrest of shallow, noncavitated carious lesions has been reported following the use of ozone.[31] Ozone is most effective in cases of shallow lesions as its penetration is about 1 mm deep at the maximum. When used in deeper lesions, excavation of the majority of caries is necessary, leaving about 1 mm of affected dentin before ozone application to the tooth and then followed by restorative placement.

Ozonated water may be used to remineralize incipient carious lesions and has been demonstrated to enhance the remineralizing potential of nano-hydroxyapatite, thus preventing the tooth from entering into the repetitive restorative cycle.[32] This could have potential clinical implications in deep carious lesions where removal of all of the affected dentin would necessitate endodontic treatment. Application of ozone gas to the prepared tooth appears as an effective and biocompatible cavity disinfectant in treatment of deep carious lesions by incomplete caries removal technique.[33] Treating the area prior to placement of the restoration may decrease the bacterial load present in the infected carious dentin, thus delaying or preventing caries-related bacterial involvement of the pulpal tissue.[34]

ROOT EXPOSURE

Gingival recession frequently can lead to mechanical or chemical breakdown of the exposed dentin. This is related to patients' oral habits, diet, and other factors. We have all encountered patients with root exposure that demonstrates no structural changes of the dentin and is stable over long periods of time. Other patients have root sensitivity with varying amounts of dentin exposure. Patients with structural breakdown that has initiated but is beyond remineralization methods will require conservative treatment to arrest further breakdown and eliminate any sensitivity associated with root exposure. Conservative treatment of these initial root areas aids in preservation of tooth structure, is atraumatic, and frequently can be performed without use of local anesthetic with minimal preparation.[35,36]

The increase in the aging population and preservation of teeth into later decades (70s and older) have shown a growing incidence of root exposure with subsequent dentin breakdown.[37,38] This becomes increasingly problematic in elderly patients with declining health or mental changes, such as dementia, that limit the ability to maintain oral hygiene. Material selection for treatment of these root areas is either a glass ionomer (conventional or resin-modified), silver diamine fluoride (SDF), or resin-based material (adhesive composite). Root surfaces are easily contaminated with saliva during treatment, causing retention issues with bonded composites; thus, glass ionomer or SDF are more predictable materials to use. An additional benefit is fluoride release over time, which aids in prevention of secondary dentin breakdown.[39]

Silver diamine fluoride demonstrates a high caries arrest rate (96%) and prevention (70%) compared to other materials.[40,41] However, tooth discoloration is a drawback if SDF is used as the sole material, and is frequently objectionable to the patient. This can be overcome by placement of a glass ionomer material over the SDF, which provides good adhesion to the SDF and is opaque enough to block out any potential visible dark staining.[42]

DISCUSSION

Long-term maintenance of the dentition correlates with preservation of tooth structure and should be the goal of restorative treatment. Identification of demineralization of the enamel should be at the first sign of breakdown of tooth structure. When confined to the enamel with no dentin involvement, the practitioner can use techniques to remineralize the affected enamel. Patients presenting with generalized chalky areas can benefit from at-home care with products that improve enamel mineralization. Diet modification should be considered to decrease foods and beverages that may increase demineralization and caries potential. Isolated chalky areas may be best treated by resin infiltration to strengthen the enamel and prevent further breakdown. This may also be applied interproximally when small incipient lesions that have not reached the dento-enamel junction are noted radiographically.

When the area of structural breakdown has reached the underlying dentin, conservative preparation allows access to those areas while preserving surrounding unaffected dentin and enamel. Areas of caries that are more extensive can be clinically challenging when using metal burs (stainless steel and carbide) to excavate the deep caries, since tactile feel may not be sufficient to determine affected versus unaffected dentin and can lead to an unintended pulpal exposure. Polymer burs in a slow-speed handpiece permit selective dentin removal and decrease potential for pulpal exposure. Decay depth will dictate removal treatment of small areas of residual affected dentin. Ozone may allow isolated small areas to remain in the tooth preparation while inactivating any bacteria contained therein, preventing further dentin breakdown and possibly delaying or eliminating the need for endodontic treatment in vital teeth.

Glass ionomer and SDF restorative materials have been helpful in treatment of root exposure when minimal caries are noted or in elderly patients who may see higher caries rates on exposed root areas. These materials have demonstrated good adhesion in areas that are challenging to get adequately dry for placement of traditional adhesive resin restorations. Additionally, their fluoride release over time may prevent caries recurrence in susceptible patients.

CONCLUSION

Identification of tooth structure breakdown

and treatment at its earliest stages allow the best opportunity to preserve critical enamel and dentin. Long-term tooth survival has been correlated to preservation of native tooth structure, and no restorative material currently in use can replicate sound enamel and dentin.

REFERENCES

1. American Dental Association. Council on Access, Prevention, and Interprofessional Relations. Caries diagnosis and risk assessment. A review of preventive strategies and management. *J Am Dent Assoc.* 1995 Jun;126(suppl):1S-24S.
2. Bader JD, Brown JP. Dilemmas in caries diagnosis. *J Am Dent Assoc.* 1993 Jun;124(6):48-50.
3. Dodds MW. Dilemmas in caries diagnosis—applications to current practice and need for research. *J Dent Educ.* 1993 Jun;57(6):433-438.
4. van Dorp CS, Exterkate RA, ten Cate JM. The effect of dental probing on subsequent enamel demineralization. *ASDC J Dent Child.* 1988 Sep-Oct;55(5):343-347.
5. Wu L, Geng K, Gao Q. Early caries preventive effects of casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) compared with conventional fluorides: a meta-analysis. *Oral Health Prev Dent.* 2019;17(6):495-503. doi:10.3290/j.ohpd.a43637.
6. Reynolds EC, Cai F, Cochrane NJ, et al. Fluoride and casein phosphopeptide-amorphous calcium phosphate. *J Dent Res.* 2008 Apr;87(4):344-348.
7. Li J, Xie X, Wang Y, et al. Long-term remineralizing effect of casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) on early caries lesions in vivo: a systematic review. *J Dent.* 2014 Jul;42(7):769-77. doi:10.1016/j.jdent.2014.03.015.
8. Thimmaiah C, Shetty P, Shetty SB, et al. Comparative analysis of the remineralization potential of CPP-ACP with fluoride, tri-calcium phosphate and nano hydroxyapatite using SEM/EDX—An *in vitro* study. *J Clin Exp Dent.* 2019 Dec 1;11(12):e1120-e1126. doi:10.4317/jced.55941.
9. Attiguppe P, Malik N, Ballal S, Naik SV. CPP-ACP and fluoride: a synergism to combat caries. *Int J Clin Pediatr Dent.* 2019 Mar-Apr;12(2):120-125. doi:10.5005/jp-journals-10005-1608.
10. Ebrahimi M, Mehrabkhani M, Ahrari F, et al. The effects of three remineralizing agents on regression of white spot lesions in children: A two-week, single-blind, randomized clinical trial. *J Clin Exp Dent.* 2017 May 1;9(5):e641-e648. doi:10.4317/jced.53582.
11. Heshmat H, Ganjkar MH, Miri Y, Fard MJ. The effect of two remineralizing agents and natural saliva on bleached enamel hardness. *Dent Res J (Isfahan).* 2016 Jan-Feb;13(1):52-57. doi:10.4103/1735-3327.174713.
12. Shivanna V, Shivakumar B. Novel treatment of white spot lesions: a report of two cases. J Conserv Dent. 2011 Oct;14(4):423-426. doi:10.4103/0972-0707.87217.
13. Gugnani N, Pandit IK, Gupta M, Josan R. Caries infiltration of noncavitated white spot lesions: a novel approach for immediate esthetic improvement. *Contemp Clin Dent*. 2012 Sep;3(Suppl 2):S199-202. doi:10.4103/0976-237X.101092.
14. Ekizer A, Zorba YO, Uysal T, Ayrikcila S. Effects of demineralization-inhibition procedures on the bond strength of brackets bonded to demineralized enamel surface. *Korean J Orthod*. 2012 Feb;42:17-22. doi:10.4041/kjod.2012.42.1.17.
15. Yuan H, Li J, Chen L, et al. Esthetic comparison of white-spot lesion treatment modalities using spectrometry and fluorescence. *Angle Orthod*. 2014 Mar;84(2):343-349. doi:10.2319/032113-232.1.
16. Mandava J, Reddy YS, Kantheti S, et al. Microhardness and penetration of artificial white spot lesions treated with resin or colloidal silica infiltration. *J Clin Diagn Res*. 2017 Apr;11(4):ZC142–ZC146. doi:10.7860/JCDR/2017/25512.9706.
17. Taher NM, Alkhamis HA, Dowaidi SM. The influence of resin infiltration system on enamel microhardness and surface roughness: an *in vitro* study. *Saudi Dent J.* 2012 Apr;24(2):79-84. doi:10.1016/j.sdentj.2011.10.003.
18. Meyer-Lueckel H, Paris S. Improved resin infiltration of natural caries lesions. *J Dent Res.* 2008 Dec;87:1112-1116. doi:10.1177/154405910808701201.
19. Kumar H, Palamara JEA, Burrow MF, Manton DJ. An investigation into the effect of a resin infiltrant on the micromechanical properties of hypomineralised enamel. *Int J Paediatr Dent.* 2017 Nov;27(5):399-411. doi:10.1111/ipd.12272.
20. Aziznezhad M, Alaghemand H, Shahande Z, et al. Comparison of the effect of resin infiltrant, fluoride varnish, and nano-hydroxy apatite paste on surface hardness and streptococcus mutans adhesion to artificial enamel lesions. *Electronic Physician.* 2017;9(3):3934-3942. doi:10.19082/3934.
21. Perdigão J. Resin infiltration of enamel white spot lesions: an ultramorphological analysis. *J Esthet Restor Dent.* 2019 Nov 19. doi:10.1111/jerd.12550.
22. National Center for Health Statistics. Centers for Disease Control and Prevention. National Health and Nutrition Examination Surveys 1999-2004. cdc.gov/nchs/nhanes.htm. Accessed Oct. 2, 2007.
23. Cvikl B, Moritz A, Bekes K. Pit and fissure sealants—a comprehensive review. *Dent J.* 2018 Jun;6(2):18. doi:10.3390/dj6020018.
24. Wright JT, Tampi MP, Graham L, et al. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars. *Pediatr Dent.* 2016;38(4):282-308.
25. Wright JT, Tampi MP, Graham L, et al. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars: A systematic review of randomized controlled trials—a report of the American Dental Association and the American Academy of Pediatric Dentistry. *J Am Dent Assoc.* 2016 Aug;147(8):631-645.e18. doi:10.1016/j.adaj.2016.06.003.
26. Isik EE, Olmez A, Akca G, Sultan N. A microbiological assessment of polymer and conventional carbide burs in caries removal. *Pediatr Dent.* 2010 Jul-Aug;32(4):316-323.
27. Broadwater WT, Hoehn RC. Sensitivity of three selected bacterial species to ozone. *Appl Microbiol.* 1973 Sep;26(3):391-393.
28. Bocci V. Autohaemotherapy after treatment of blood with ozone. A reappraisal. *J Int Med Res.* 1994 May-Jun;22(3):131-144.
29. Elvis AM, Ekta JS. Ozone therapy: a clinical review. *J Nat Sci Biol Med.* 2011 Jan;2(1):66-70.
30. Kumar A, Bhagawati S, Tyagi P, Kumar P. Current interpretations and scientific rationale of the ozone usage in dentistry: a systematic review of literature. *Eur J Gen Dent.* 2014 3(3):175-180.
31. Lynch E. Ozone Caries Management. Published 2008. https://pdfs.semanticscholar.org/48de/28dad7b6ff0d63041cd040f82ebc1bf5852c.pdf.
32. Samuel SR, Dorai S, Khatri SG, Patil ST. Effect of ozone to remineralize initial enamel caries: in situ study. *Clin Oral Investig.* 2016 Jun;20(5):1109-1113. doi:10.1007/s00784-016-1710-x.
33. Krunic J, Stojanovic N, Dukic L, et al. Clinical antibacterial effectiveness and biocompatibility of gaseous ozone after incomplete caries removal. *Clin Oral Investig.* 2019 Feb;23(2):785-792. doi:10.1007/s00784-018-2495-x.
34. Libonati A, Di Taranto V, Mea A, et al. Clinical antibacterial effectiveness Healozone Technology after incomplete caries removal. *Eur J Paediatr Dent.* 2019 Mar;20(1):73-78. doi:10.23804/

ejpd.2019.20.01.14.
35. Dorri M, Martinez-Zapata MJ, Walsh T, et al. Atraumatic restorative treatment versus conventional restorative treatment for managing dental caries. *Cochrane Database Syst Rev.* 2017 Dec 28;12:CD008072. doi:10.1002/14651858.CD008072.pub2.
36. Burrow MF, Stacey MA. Management of cavitated root caries lesions: minimum intervention and alternatives. *Monogr Oral Sci.* 2017;26:106-114. doi:10.1159/000479352.
37. Gregory D, Hyde S. Root caries in older adults. *J Calif Dent Assoc.* 2015 Aug;43(8):439-445.
38. Larson TD. Root caries: causes, prevention, and treatment. *Northwest Dent.* 2015 Nov-Dec;94(6):21-22, 24, 26-28.
39. Wiegand A, Buchalla W, Attin T. Review on fluoride-releasing restorative materials—fluoride release and uptake characteristics, antibacterial activity and influence on caries formation. *Dent Mater.* 2007 Mar;23(3):343-362.
40. Mei ML, Zhao IS, Ito L, et al. Prevention of secondary caries by silver diamine fluoride. *Int Dent J.* 2016 Apr;66(2):71-77. doi:10.1111/idj.12207.
41. Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet." *J Dent Res.* 2009 Feb;88(2):116-125. doi:10.1177/0022034508329406.
42. Seifo N, Robertson M, MacLean J, et al. The use of silver diamine fluoride (SDF) in dental practice. *Br Dent J.* 2020 Jan;228(2):75-81. doi:10.1038/s41415-020-1203-9.
43. Selwitz RH, Winn DM, Kingman A, Zion GR. The prevalence of dental sealants in the US population: findings from NHANES III, 1988-1991. *J Dent Res*. 1996;75 Spec No:652–660. doi:10.1177/002203459607502S05

GREGORI M. KURTZMAN, DDS, DADIA, DICOI, DIDIA, FACD, FPFA, MAGD, is in private general dental practice in Silver Spring, Maryland, and is a former assistant clinical professor at University of Maryland in the departments of restorative dentistry and endodontics. Dr. Kurtzman has lectured internationally on the topics of restorative dentistry, endodontics, implant surgery and prosthetics, removable and fixed prosthetics, and periodontics. He can be reached at dr_kurtzman@maryland-implants.com.

NOTES

QUICK ACCESS CODE 15437

ONLINE COMPLETION

Take this test online for immediate credit. Visit **dentalacademyofce.com** and sign in. If you have not previously purchased the course, select it from the "Online Courses" listings and complete your purchase. The exam will then be added to your "Archives" page, where a "Take Exam" link will be provided. Click on this link, complete all questions, and submit your answers. An immediate grade report will be generated. If you receive a score of 70% or higher, your verification form will be provided immediately for viewing and printing. View and print forms at any time by visiting the site and returning to your "Archives" page.

QUESTIONS

1. Cavitation is defined as:

A. Caries that involves the dentin
B. Chalky areas on the enamel
C. Microstructural damage to the enamel, exposing the underlying dentin
D. Macrostructural damage to the enamel, exposing the underlying dentin

2. What can cause cavitation?

A. Explorer tip contact with mineralized enamel at the pit
B. Explorer tip contact with demineralized enamel at the pit
C. Abrasion of the enamel with a coarse toothbrush
D. Occurs during tooth preparation

3. Early changes in the tooth can be identified as:

A. Color alteration to the enamel compared to the surrounding tooth structure
B. Chalky spots on the enamel
C. Darker areas on exposed root dentin
D. All of the above

4. White spots in the pits and fissures without surface breakdown may best be treated with:

A. Remineralization
B. Minimally invasive restorations
C. Laser enamel fusion
D. Ultrasonic cavitation

5. Initial demineralization may be indicative of:

A. Systemic issues such as diabetes
B. Low carbohydrate diet
C. Weaker areas of the enamel
D. Weaker areas of underlying dentin

6. A chalky area present with sensitivity typically indicates:

A. Shallow penetration of demineralization approaching the DEJ
B. Deeper penetration of demineralization extending to the DEJ
C. Occlusal parafunction as a component
D. Sensitivity is typically not correlated with the area.

7. Minor enamel demineralization can be identified as:

A. White spots
B. Dark spots
C. Enamel crazing
D. Enamel cupping

8. WSLs are not typically seen in/on:

A. Flat tooth surfaces
B. Cusp tips
C. Fissures
D. Pits

9. At-home remineralization products may contain:

A. Casein phosphopeptide-amorphous calcium phosphate
B. Casein phosphopeptide-amorphous calcium phosphate with fluoride
C. Water-based cream containing hydroxyapatite, fluoride, and xylitol
D. All of the above

10. White-spot lesions without penetration to the DEJ may be treated conservatively with:

A. Microabrasion
B. Resin infiltration
C. Laser preparation
D. Fissurotomy burs

11. Subsurface enamel porosities caused by a cyclical imbalance between demineralization and remineralization of the enamel describes:

A. White-spot lesions
B. Incipient lesions
C. Cavitated lesions
D. Hypercalcified enamel

12. Over time, remineralization of the outer surface of the tooth decreases the access of calcium and other ions to deeper portions of the enamel, eventually:

A. Accelerating the lesion
B. Arresting the lesion
C. Causing tooth sensitivity
D. Causing cavitation

13. Enamel demineralization and WSLs represent:

A. Advanced incipient lesions
B. Esthetic issues only
C. First stage of caries
D. Secondary caries

14. Etiology of white spots relates to:

A. Infiltration of pathogenic bacteria through the surface of the enamel
B. Organic acids produced by bacteria within the demineralized enamel
C. Dissolution of calcium and phosphate ions of the dental structure
D. All of the above

15. White spots:

A. Result when microporosities within the hypocalcified enamel are filled with either a watery medium or air
B. Result from hypercalcified enamel reflecting light
C. Are initial lesions that appear to fluoresce under ambient light
D. Are caused by ambient light that shines on the teeth being absorbed

QUICK ACCESS CODE 15437

ONLINE COMPLETION

Take this test online for immediate credit. Visit **dentalacademyofce.com** and sign in. If you have not previously purchased the course, select it from the "Online Courses" listings and complete your purchase. The exam will then be added to your "Archives" page, where a "Take Exam" link will be provided. Click on this link, complete all questions, and submit your answers. An immediate grade report will be generated. If you receive a score of 70% or higher, your verification form will be provided immediately for viewing and printing. View and print forms at any time by visiting the site and returning to your "Archives" page.

QUESTIONS

16. With resin infiltration, a very low viscosity resin:

A. Is applied to the enamel surface and allowed to self-cure
B. Is applied daily as part of routine home care
C. Acts by occluding porosity by capillary forces
D. Acts by refracting light on the enamel surface to optically eliminate the white spot

17. Resin infiltration is:

A. An alternative to traditional restorations
B. Used with traditional restorations
C. An intermediary treatment between preventive and restorative therapy
D. Used as an aid to identify the lesion before preparation

18. When infiltrated with resin, the white spot will:

A. Better blend with adjacent normal enamel
B. Completely disappear visually
C. Become more hypersensitive
D. Work best with hypercalcified enamel

19. Restorative treatment has moved increasingly toward:

A. Conservation of tooth structure
B. Early identification
C. Early intervention
D. All of the above

20. Which part of the tooth is the most critical to preserve for tooth longevity?

A. Cusps
B. Interproximals
C. Buccal/lingual
D. Cervical

21. Under functional loading, where is stress concentrated on the tooth?

A. Cusps
B. Interproximals
C. Buccal/lingual
D. Cervical

22. Pit and fissure depth and width:

A. Are normally wider than deeper
B. Are uniform when incipient lesions are present
C. Are uniform from patient to patient in noncarious teeth
D. Vary from patient to patient in healthy, noncarious involved teeth

23. What percent of caries in primary teeth originates in the pits and fissures?

A. 24%
B. 34%
C. 44%
D. 54%

24. We see fewer caries in adults than in children because of:

A. Adults having more frequent dental visits
B. Pits and fissures having already been restored
C. Adults having shallower pits and fissures
D. Improved home care and diets lower in carbohydrates

25. Fissurotomy burs allow:

A. Conservation of surrounding tooth structure when preparing the tooth
B. Routine use without anesthetic
C. Creation of wider, shallower preparations
D. Use in slow-speed handpieces for more precise preparations

26. Smartburs are fabricated from:

A. Zirconia
B. Stainless steel
C. Carbide steel
D. Polymer

27. Ozone has been shown to cause the inactivation of:

A. Bacteria
B. Viruses
C. Fungi and yeast
D. All of the above

28. Ozonated water may be used to:

A. Improve bonding adhesion
B. Remineralize incipient carious lesions
C. Decrease gingival bleeding
D. Improve enamel hypersensitivity

29. Which population shows a greater incidence of root caries?

A. Children
B. Adolescents
C. Adults
D. Elderly

30. Use of SDF may result in:

A. Silver toxicity in many patients
B. Potential autoimmune reaction is some patients
C. Dark discoloration of the tooth
D. Pulpal hypersensitivity

PUBLICATION DATE:	MAY 2020
EXPIRATION DATE:	APRIL 2023

ANSWER SHEET

Caries management: When, why, and how

Name: Title: Specialty:

Address: Email: AGD member ID (if applies):

City: State: ZIP: Country:

Telephone: Primary ( ) Office ( ) License renewal date:

Requirements for obtaining CE credits by mail/fax: 1) Read entire course. 2) Complete info above. 3) Complete test by marking one answer per question. 4) Complete course evaluation. 5) Complete credit card info or write check payable to Endeavor Business Media. 6) Mail/fax this page to DACE. A score of 70% is required for CE credit. **For questions, call (800) 633-1681. Course may also be completed at dentalacademyofce.com.**

EDUCATIONAL OBJECTIVES

1. Describe how to treat white-spot lesions
2. Identify what treatments can be employed for conservative caries treatment of incipient lesions
3. Describe treatments that may be employed for root exposure

COURSE EVALUATION

1. Were the individual course objectives met?

Objective #1: Yes No Objective #2: Yes No

Objective #3: Yes No Objective #4: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

2. To what extent were the course objectives accomplished overall?	5	4	3	2	1	0
3. Please rate your personal mastery of the course objectives.	5	4	3	2	1	0
4. How would you rate the objectives and educational methods?	5	4	3	2	1	0
5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
6. Please rate the instructor's effectiveness.	5	4	3	2	1	0
7. Was the overall administration of the course effective?	5	4	3	2	1	0
8. Please rate the usefulness and clinical applicability of this course.	5	4	3	2	1	0
9. Please rate the usefulness of the supplemental webliography.	5	4	3	2	1	0

10. Do you feel that the references were adequate? Yes No

11. Would you participate in a similar program on a different topic? Yes No

12. If any of the continuing education questions were unclear or ambiguous, please list them.

_____

13. Was there any subject matter you found confusing? Please describe.

_____

14. How long did it take you to complete this course?

_____

15. What additional continuing dental education topics would you like to see?

_____

Mail/fax completed answer sheet to:

Endeavor Business Media
Attn: Dental division
7666 E. 61st St. Suite 230, Tulsa, OK 74133
Fax: (918) 831-9804

☐ Payment of $59 is enclosed.
Make check payable to Endeavor Business Media

If paying by credit card, please complete the following: ☐MC ☐Visa ☐AmEx ☐Discover

Acct. number: _____

Exp. date: _____ CVC #: _____

Billing address: _____

_____

Charges on your statement will show up as PennWell / Endeavor.

1.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	16.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	17.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

AGD code: 250

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

INSTRUCTIONS
All questions have only one answer. Grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a verification form. Verification of Participation forms will be mailed within two weeks after taking an examination.

COURSE EVALUATION AND FEEDBACK
We encourage participant feedback. Complete the survey above and e-mail feedback to Aileen Gunter (agunter@endeavorb2b.com) and Laura Winfield (lwinfield@endeavorb2b.com).

COURSE CREDITS AND COST
All participants scoring at least 70% on the examination will receive a verification form for three CE credits. The formal CE program of this sponsor is accepted by the AGD for fellowship and mastership credit. Please contact Endeavor for current term of acceptance. Participants are urged to contact their state dental boards for continuing education requirements.

PROVIDER INFORMATION
Endeavor is an ADA CERP–recognized Provider. ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP neither approves nor endorses individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry. Concerns about a CE provider may be directed to the provider or to ADA CERP at ada.org/gotocerp/.

Endeavor is designated as an approved PACE program provider by the Academy of General Dentistry. The formal continuing dental education programs of this program provider are accepted by the AGD for fellowship, mastership, and membership maintenance credit. Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. The current term of approval extends from 11/1/2019 to 10/31/2022. Provider ID# 320452.

RECORD KEEPING
Endeavor maintains records of your successful completion of any exam for a minimum of six years. Please contact our offices for a copy of your CE credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

EDUCATIONAL DISCLAIMER
Completing a single CE course should not provide enough information to give participants the feeling that they are experts in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

CANCELLATION AND REFUND POLICY
Any participant who is not 100% satisfied with this course can request a full refund by contacting Endeavor in writing.

IMAGE AUTHENTICITY
The images provided and included in this course have not been altered.