Management of Patients With Active Caries
Peter Milgrom, DDS

ABSTRACT This paper reports on a mechanism to manage caries as a disease and to medically intervene in the disease process to halt progression. The goal of this paper is to provide this alternative to a surgical-only approach. The management of caries begins with assessing lesion activity and the potential for arrest. This requires a clinical and radiological assessment and evaluation of risk. Hopeless teeth are extracted and large cavities filled to reduce infection. Risk reduction strategies are employed so efforts to arrest lesions can be successful. Teeth with lesions in the enamel or outer third of the dentin should be sealed, not restored, as restorations can weaken teeth and can be traumatic to pulps.

AUTHOR

Peter Milgrom, DDS, is professor of Dental Public Health Sciences and Pediatric Dentistry in the School of Dentistry and adjunct professor of Health Services in the School of Public Health and Community Medicine at the University of Washington. He also directs the university’s Northwest Center to Reduce Oral Health Disparities. Dr. Milgrom maintains a practice limited to the care of fearful patients and was the director of the Dental Fears Research Clinic at the University of Washington. Conflict of Interest Disclosure: None reported.

Historically, there was little difference between detecting a carious lesion and placing a filling. There was no diagnostic step. I am reminded of a young man, 18 years old, with not a single filling. He was seen for the first time by a young dentist and left the office with multiple small Class II fillings. Indeed, his bitewing X-rays showed multiple interproximal lesions, some in the enamel and some in the outer third of the dentin. The dentist took no history, sought no records from the previous dentist, nor asked himself why a healthy individual would suddenly develop all these new lesions. Before moving to town, the patient had seen a dentist in the city where he was a student. That dentist had diagnosed these lesions, assessed risk and provided frequent topical fluoride treatments and dietary counseling to lower the caries risk. He monitored his patient frequently but placed no fillings in these otherwise intact teeth. When the lesions were opened, they were found to be hard and inactive.

The tragedy of this story is not the stark contrast in caries management styles, but that neither dentist explained to this patient the rationale for his approach, nor had the second dentist sought out the treatment records, which were readily available. Fifty or more years ago, there was no diagnostic step in a caries exam in dental practice. It was assumed that all lesions were active and that most patients had them, as this was the prefluoride period. There was generally inadequate technology available to the clinician to identify early lesions, and remineralization techniques were not widely accepted.
This history has persisted with the lack of actual diagnostic codes for dental caries disease within the CDT system until very recently. Detecting and treating were conceptually a single continuous process, with treatment decisions dictated by the size of the lesion and the pocketbook of the patient. In fact, until the 1970s, dental examinations were often free in private offices.

Collection of Information

Studies have demonstrated that a careful visual exam by a trained examiner using good light, a mirror and a blunt probe is equal to or more likely more accurate and reproducible than using laser fluorescence, especially since the testing equipment use is largely confined to accessible smooth surfaces and is ineffective in pits and fissures and interproximally. The visual tactile exam or findings from the use of the various devices results in information about the state of the teeth. Neither provides sufficient information alone for a diagnosis and treatment plan.

Bitewing radiographs are an essential part of a dental caries examination. They reveal possibly precavitated lesions with the potential for remineralization and deeper lesions that can be arrested. With ultrafast film and appropriate radiation hygiene, X-rays are safe, but digital X-rays have largely displaced traditional films. Caries lesion detection on digital films has been shown to be similar to that with traditional films, with increased safety and efficiency. Nevertheless, the inability of a single X-ray image to distinguish between cavitated and noncavitated interproximal lesions or to detect lesion activity remains the same. Fifty-six to 80 percent of lesions visible on bitewings are not cavitated. The ability to manipulate the images on the computer leads to a false confidence in the information from the films.

Studies have repeatedly demonstrated that lesion progression from the outer half of the enamel into the dentin takes three to four years in healthy children where there is water fluoridation or where fluoride toothpaste is used, but not all lesions progress. Progression is related to the initial depth of the lesion. In one study of 13-year-olds who were followed for 10 years, 63 percent of interproximal lesions detected by X-rays did not progress and 86 percent of enamel lesions remained unchanged. The point is there is always time to employ remineralization and caries arrest techniques. That is not the same as the traditional “watch,” which, in the absence of intensive efforts to change caries risk status, is simply watching things get worse.

Inactive Caries

Inactive caries usually refers to cavities that are radiographically unchanged or lesions that are dark in color and hard on visual tactile examination. Such lesions are often present at the cervical of teeth in older adults, and “burned out” carious lesions in primary teeth are common among older preschoolers whose caries risk status changed after they were weaned and switched to solid food or who received xylitol chewing gum. Sharp instruments can always damage arrested dentin, so the test is not whether the surface can be excavated. Unstandardized X-ray diagnosis of the presence or depth of lesions over time is likely to be unreliable. Variation in film and device placement precludes the dentist from making fine gradations in changes in lesions. There will be many false positives in judging lesion progression, although deeper lesions are more likely to progress.

Can a Patient Have Active and Inactive Caries?

One thinks of the patient with an inlay or onlay with cement washout or a defect in whom active caries develops when no other teeth are affected. The cause is failure of the cement and probably does not indicate that the caries risk status of the patient has changed. This situation requires management of the individual tooth and not a major shift in caries management for the patient.

Caries Risk Assessment With Active Caries Lesions

Nearly all dentists today do an informal or formal caries risk assessment. The pages of this journal have been filled with information on conducting risk assessments. However, risk is automatically moderate or high if lesions are present. The value of the assessment — used repeatedly over time — is to identify modifiable factors than can lower risk. Dental caries does not progress without some high risk factors. It is important to recognize that the most significant risk factor changes in both adults and children may stem from medical illness and medication use.

Arresting Active Caries

Control Extent of Biofilm Infection

The major dietary risk in the U.S. today is from sugar-sweetened beverages and sports drinks. Soft drinks, fruit drinks and sports drinks represent about one-
third of all added sugar consumption for children and many adults. Typical daily consumption of added sugar in 2001 was 22 teaspoons per person for the whole population.10,11 Sugar feeds the caries biofilm and results in high levels of plaque that are associated with dental caries. This pattern is not hard to identify, but many patients are unaware that these beverages and their pattern of use are the source of increased caries risk. This dietary pattern is also a frequent cause of obesity in children and teenagers. There is evidence from the obesity literature that targeted counseling and substitution of water for these beverages can be effective.12 Newer, personalized and targeted counseling approaches can also be successful.13

Antiseptics

There are two main biological arguments for adding a broad-spectrum topical antimicrobial to change caries risk. The first is that individuals with high rates of tooth decay are much more heavily colonized with pathogenic organisms than those who experience less tooth decay.14 While the primary pathogen is Streptococcus mutans, other bacteria have been associated with tooth decay. A broad-spectrum antimicrobial can be effective against a wide range of pathogens associated with dental caries.

Iodine (I2) is among the most potent of bactericidal agents, and its action is rapidly bactericidal. I2 has excellent penetration into intact dental plaque biofilm15 and its bactericidal and penetrability characteristics make it an excellent choice for dental use. A single dental prophylaxis followed by application of a 2% I2-KI solution immediately and again at three and five days following the single prophylaxis significantly reduced S. mutans levels in tooth fissure and proximal surface plaques and saliva of dental assistants and dental hygiene students. Reductions of S. mutans persisted 20-24 weeks in proximal plaque and saliva; fissure plaques were significantly suppressed for four weeks but gradually returned to baseline in the absence of dietary restrictions.16

The second argument in favor of I2 is that it is known to impact the ability of S. mutans to bind to tooth surfaces by disrupting the expression and production of glucosyltransferase by the mutants streptococci.17 Glucosyltransferase made by them is critically involved in mediation of adherence of these bacteria to the teeth biofilm and is established to be a potent virulence determinant. Furthermore, I2 has potent antifungal effects, suggesting that overgrowth of such potential pathogens should not be a concern.

Two studies, in high-risk preschoolers and school-age children, have shown that the combination of readily available povidone iodine (e.g., Betadine) plus sodium fluoride (NaF) varnish applied sequentially at the same appointment is more effective in reducing caries than fluoride varnish alone.18,19 Povidone iodine is nonstaining and does not taste or feel bad. It works on contact. The excess can be wiped off and the teeth then coated with fluoride varnish. FIGURE 1 shows this application.

Chlorhexidine rinses available in the U.S. have been shown to reduce plaque accumulation but acceptance is limited. Evidence for caries reduction from the 0.12% rinses is limited.20

Interproximal Resin Sealants

It is possible to separate teeth and infiltrate early interproximal lesions with unfilled resins. This has been done with standard unfilled resins, such as single bond products and with single purpose materials and kits. Evidence suggests that this treatment arrests the progression of these lesions.12

Promoting Remineralization

Fluorides promote remineralization both of damaged teeth and of intact tooth surfaces that may be damaged by acid-producing bacteria. In order for fluorides to work, fluoride levels in saliva and plaque must be habitually maintained. Fluoridated toothpaste used twice daily maintains salivary fluoride levels sufficient to remineralize teeth if the mutans infection is not severe. Twice-daily supervised toothbrushing with fluoridated toothpaste in schools, for example, has shown to be effective in reducing the caries rate. All fluoride toothpastes sold in the U.S. meet the FDA standard and there should be virtually no difference among them except taste and other esthetic properties. Patients with lesions that need to be managed should understand the role that toothpaste and toothbrushing play in the carious prevention process.

Topical NaF varnish is the mainstay of tooth decay prevention. However, topical fluoride alone is not sufficient to prevent tooth decay in high-risk individuals. Varnishes are especially useful because they are inexpensive, user-friendly and require minimal training to use. The varnish is applied to teeth that have been dried with gauze. Once applied, the user can immediately return to normal activities. A Cochrane critical review of fluoride varnish...
clinical trials reported the pooled D(M)FS prevented fraction estimate was 46 percent (95 percent confidence interval [CI], 30 percent to 63 percent; P < 0.0001) and the pooled d(e/m)FS prevented fraction estimate was 33 percent (95 percent CI, 19 percent to 48 percent; P < 0.0001). However, topical fluoride alone provides incomplete protection, at least in children.23

Promoting Host Defenses

Sugarless Chewing Gum

Chewing gum typically consists of a sweetener, gum base, flavoring and aromatic agent. Common claims for the benefits of gum chewing include the cleansing of food debris from teeth and plaque and stimulating salivary flow. Chewing gum is a potent stimulator of salivary flow, a function of the mechanical act of mastication. Chewing gum after meals stimulates saliva flow with increased concentration of bicarbonate that results in elevated plaque pH and enhanced acid buffering capacity. This stimulated saliva is also in a state of mineral supersaturation, which promotes enamel remineralization. Clearly, sugar-free chewing gum, especially those sweetened with polyols such as xylitol, have potential for enhancing host defense and lowering caries risk.20

Bicarbonates

Dentifrices, rinses and even chewing gum containing sodium bicarbonate or arginine bicarbonate may be helpful in restoring normal plaque pH after exposure to dietary sugars. 24-27

Surgical Management

Unrestorable teeth and those with big unfilled cavities are a reservoir of caries-causing bacteria. While modifying other risk factors may reduce the impact of this reservoir, comprehensive caries management includes removal of hopeless teeth and restoration of large cavities so that the remaining teeth can return to function. The choice of material depends largely on the physical characteristics of the cavity and esthetic considerations. Smaller occlusal lesions can be sealed using pit and fissure sealants carefully placed in a scrupulously dry field. Some interproximal lesions can be sealed or resin impregnated if the surface is accessible. Lesions under carefully placed restorations, especially amalgam and glass ionomer cement (GIC), typically arrest.28,29 Some of the GIC materials release fluoride and protect surrounding areas, but in practice, it is difficult to know whether a particular material has that potential. However, GIC will serve as a fluoride reservoir when treated topically with varnish. Nevertheless, caries organisms colonize the margins of all restorations.

Cavities in Permanent Teeth

Noncavitated lesions and those in the outer third of the dentin have the potential for remineralization or arrest and should not be filled. Small lesions can be minimally excavated, treated with GIC and then sealed if accessible. Deeper lesions in permanent molars — where the pulp would be exposed if conventional treatment were carried out — can be opened minimally with a bur, excavated only to provide retention and filled with GIC. The surface can then be sealed. This maximizes the potential for maintaining pulp vitality and avoids root canal treatments that are expensive and can be problematic in teeth without fully formed root apices.

A special case exists for primary teeth, especially molars, with interproximal caries. Traditional treatment has required cavity or crown preparation that often results in pulp exposure. This approach is expensive and problematic in many younger children unless they are under deep sedation or general anesthesia. It has been demonstrated that simply cementing a stainless steel crown over the unprepped tooth with GIC arrests the caries and allows the pulp to initiate repair mechanisms.30 These treatments are provided without local anesthetic injection and are possible even in precooperative children. The occlusion adjusts within a couple of weeks. The teeth are then exfoliated normally. In the worst case, pulp treatments can be provided through the already-cemented crown.

Many older fillings, especially amalgams, are replaced because dentists detect recurrent caries at the margins of such fillings. The information may come from exploring a margin with a sharp explorer or from an X-ray image. Many of these teeth do not demonstrate active decay and can be observed or repaired.31 Most dentists today see older adults with amalgam fillings placed 30 or more years earlier. They have rarely failed because of dental caries, but more likely because of a cusp fracture resulting from overly large cavity preparations.

Potential New Products

New products such as diamine silver fluoride or a PVP-I containing fluoride varnish may be on the horizon. Active research is ongoing and companies are working to address regulatory hurdles and bring these new materials to market. These products have the potential to further enhance the dentist’s ability to manage dental caries lesions. Diamine
silver fluoride (also called silver diamine fluoride or silver fluoride) has been heavily studied and its effectiveness is well documented. Figure 2 shows an adult patient who was treated with surgery and radiation for squamous cell carcinoma of the tongue. He subsequently developed severe dry mouth and cervical caries. He sought care from the author, who treated the lesions topically with diamine silver fluoride. He was also counseled on careful toothbrushing with fluoridated toothpaste and the use of chlorhexidine rinses to minimize plaque accumulation. The lesions turned dark and arrested. His salivary flow improved somewhat but he still experiences dry mouth. The lesions are retreated every six months and have been stable for five years. He has developed no new cavities. It has been suggested that topical silver nitrate, used in conjunction with fluoride varnish, may have similar effects. The commonality of these agents is that they are all antimicrobial.

Conclusion
Patients may expect traditional treatment and be concerned when lesions go unfilled, or the dentist may be fearful that lesions will progress unchecked. It is reasonable to decrease the interval between examinations or to increase the use of targeted radiographs in cases where lesions are being followed without surgical intervention. Frequency of examinations should always be based on risk status. Given the generally slow progression of active lesions, this approach provides reassurance and protection for the patient, assuming the plan is adequately explained. Recurrent caries around fillings when caries risk is high and unmodified after placement is more serious than the risk that a noncavitated lesion will progress. Thus, placing a filling provides false confidence for the patient who may not be seen on a regular basis.