Caries Diagnosis: The Necessity for a New Standard of Care

By Kenneth S. Magid, DDS

Clinical investigation of fissure caries with a mirror and explorer has, for many years, been the generally accepted method of detecting carious lesions. It is the most typical and basic part of dental examinations and is still taught in dental schools and carried out in most dental offices. Yet there is conclusive evidence that this method of investigation is not only highly inaccurate, but may actually be harmful.

We must, therefore, turn to new technologies such as the intraoral camera and microabrasion to provide alternatives. It is essential that we, as professionals, continually examine our beliefs and practices in light of new information. Even our most basic principles must stand up to this scrutiny.

Paradigm and Paradigm Shift

One of the most overused buzz-words in the 1990s is "paradigm." Webster defines paradigm as an "archetype," or an original example or principle on which others are based. The most basic paradigm in dentistry is that *enamel undermined by decay will collapse.* This principle is at the heart of our diagnosis of pit and fissure caries with an explorer. In using this diagnostic technique we depend on the caries penetrating the fissure or groove and undermining the surrounding enamel rods, causing them to collapse. This permits the explorer, which would normally be too large to enter the groove, to penetrate and get the "stick" we have been taught to recognize as indicating caries (Fig. 1). The problem is that the basic paradigm is no longer true.

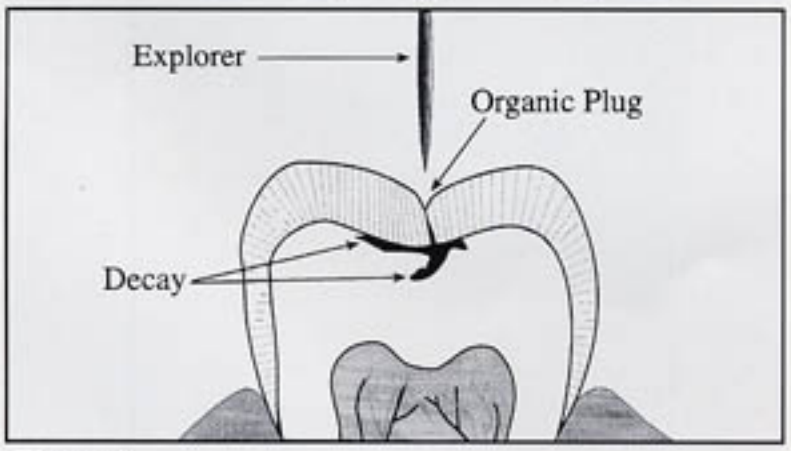

Figure 1

Current research shows that despite fluoride's excellent role in reducing smooth surface caries it has had one unexpected effect. When strengthened by fluoride, enamel undermined by decay is much less likely to collapse.[1-4] The result is that the detection of caries in pits, fissures, and grooves can not be reliably done with an explorer.[1,3,5-7] In addition, reports have called into question the effectiveness of radiographs and other diagnostic methods in locating pit and fissure caries.[1,3,7,8] In one study, 100 extracted molars were evaluated. A new, ultra-sharp explorer was used to probe each tooth, and suspected areas of decay were recorded. The teeth were then sectioned in thin slices and radiographed to find the actual caries. The result was that only 24% of the carious lesions were discovered by probing.[4]

To those of us practicing "in the trenches," personal experience brings a point home better than the research studies. During my lectures I always pose the following question: "How many of you have begun what you believed to be a small area of decay in a pit or fissure, to be shocked by a seriously carious tooth? And some of these teeth, when finally excavated, are nothing more than a shell." Universally, the doctors in the audience indicate they have had similar experiences. If enamel undermined by decay will collapse as we have believed, not only would an explorer have found the problem sooner, but *these hollowed-out teeth could not exist.* They would have collapsed into craters long before this point. These doctors were all careful, caring practitioners. The problem is not them, but adhering to a "standard of care" that is no longer valid.

A New Standard of Care

There is a preponderance of evidence that continuing to diagnose with an explorer and radiographs will miss the majority of decayed teeth. Therefore, as professionals, we must change our techniques and adopt a standard of care that is supported by research and clinical findings. The combination of the intraoral camera with microabrasive dentistry has made possible a "new standard of care."

The first step in the procedure is examination of all tooth surfaces with the intraoral camera. The ability to enlarge a

single tooth up to 10 to 12 inches permits observation of subtle changes that would not be possible with the naked eye or the use of loupes. Areas that exhibit changes in light transmission, color, or reflectance are recorded for further evaluation (Figs. 2a and 2b). The experience of those using and writing about the technique is that approximately 80% of teeth observed to have these changes are decayed beyond the dentoenamel junction and over 70% are substantially decayed. The problem is that visual examination alone is an unreliable criteria, and we don't know which are which (Figs. 3a-c).[9,10]

Figure 2a

Figure 2b

Once the suspect teeth are recorded the stain and organic plug (see Fig. 1) are cleaned with a micro abrasion device (KCP1000 and KCP 100, American Dental Technologies, Southfield, Michigan) using short bursts of 27µ medical grade alpha alumina particles at 40 psi. The choice of material and particle size are important since they are capable of removing the stain and organic plug without removing healthy enamel. Other powders used by microabrasion devices are 27µ industrial grade alpha alumina or 50µ alpha alumina. Industrial grade alpha alumina is harder and more aggressive than medical grade and even at lowered pressure removes more tooth structure than desirable in the evaluation phase. In addition, industrial grade alpha alumina may contain SiO_2, CrO_3, or other elements that are of questionable safety. Also too aggressive for the evaluation phase is 50µ alpha alumina. Other authors have indicated that a sodium bicarbonate stream used in an air slurry polisher or a microabrasion device set up for this powder is an alternative.[11] I have found this method to be less successful in removing all stains and the organic plug.

With the stain and organic plug removed, the tooth is

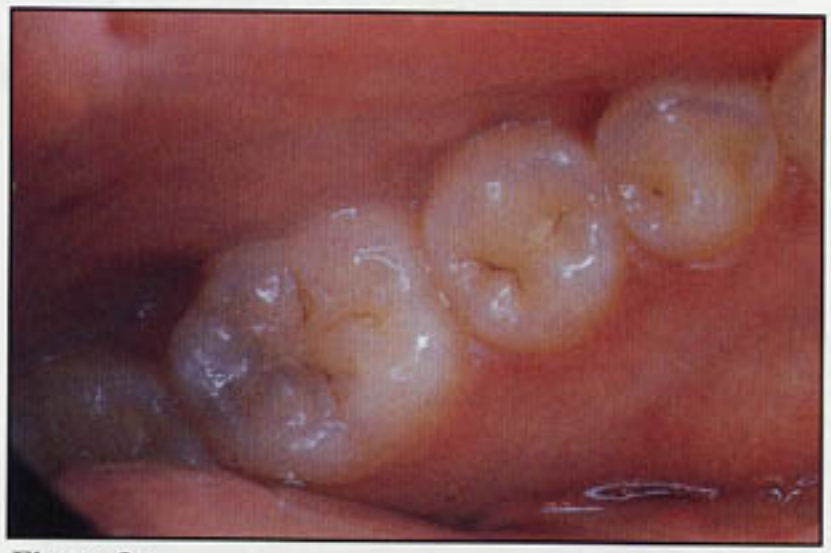

Figure 3a

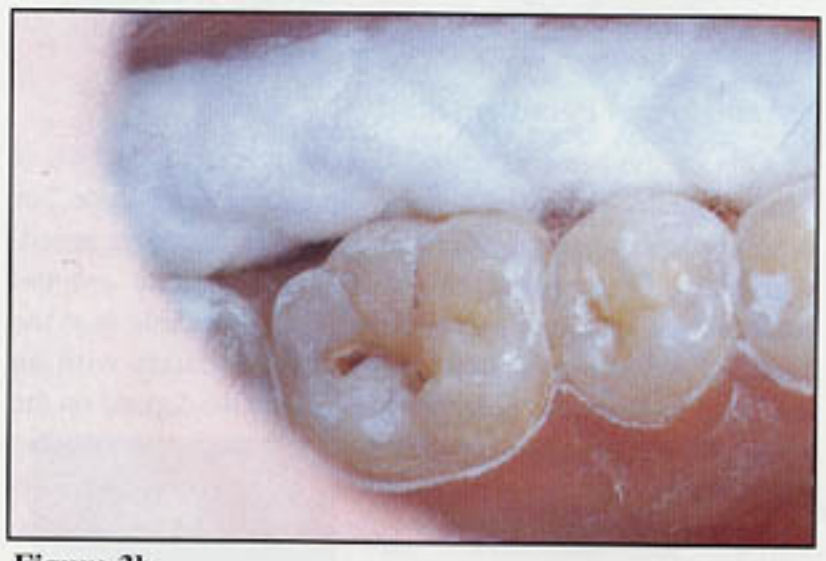

Figure 3b

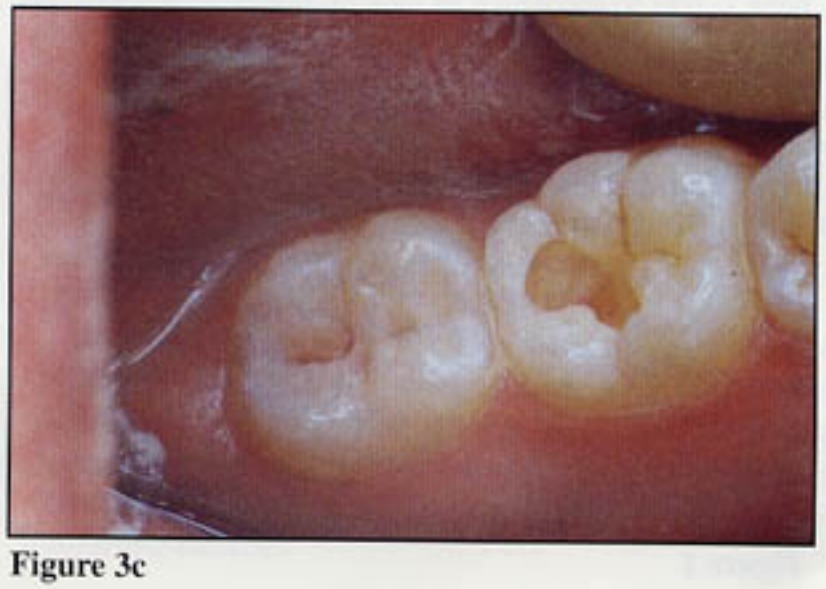

Figure 3c

Figure 4a

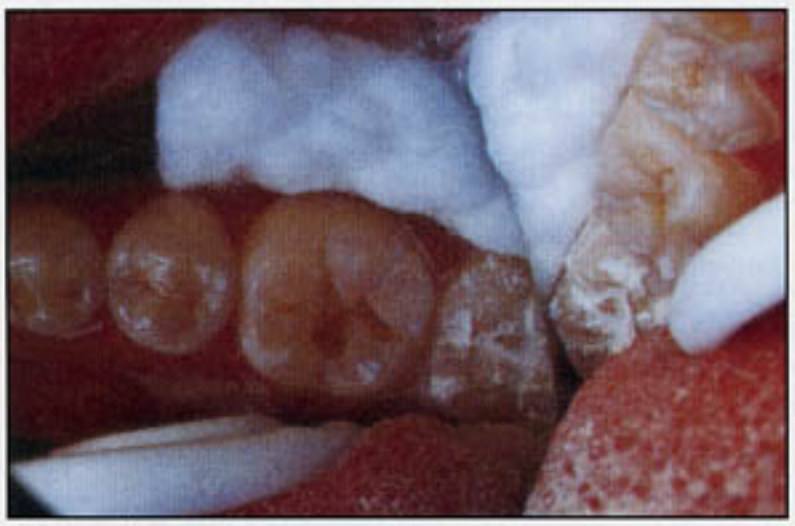

Figure 4b

examined using the intraoral camera or magnification. If no further discoloration is present the groove may be left alone or treated with a traditional sealant. In many States removal of the organic plug with microabrasion can be carried out by the dental hygienist after proper training and practice. This is an efficient way to manage this area of treatment. The hygienist can more economically carry out the "exploration and evaluation" phase and, if the dentist finds that no further treatment is necessary, dismiss the patient or place a traditional sealant.

If the discoloration extends beyond the superficial organic plug, the tooth is diagnosed as decayed. The patient can then be treated at that time or rescheduled for further treatment. Since the tooth has not been "prepared," there is no risk of sensitivity or increased damage by postponing the procedure.

Although most of the teeth when excavated are found to be substantially carious, the question arises about the teeth that are minimally involved; previously called incipient decay. In the past, we have been taught it was not in our patient's best interest to remove these areas since there was question as to whether some of them are self limiting, and in treating them in the traditional fashion the cure was worse than the disease. To take a bur and destroy almost a third of the tooth, penetrate into the dentin causing histologic changes in the pulp, create microfractures in the enamel, and then place an amalgam that looks ugly and will probably promote recurrent decay and lost cusps, all for a little decay that may or may not be a problem was considered overkill. It was thought, why treat early when we can wait and watch the decay to see if a large area develops.

We now know that waiting for the traditional clinical and radiographic indications of substantial decay is undependable and puts the tooth at great risk. In addition, treatment with microabrasion and restoration with composite causes none of the histologic changes, microfracturing, or excessive loss of tooth structure that were behind our previous decision to withhold treatment.

Handpiece or Microabrasion

The question is sometimes asked whether this evaluation of pits and fissures can be done with a handpiece rather than microabrasion. A few short bursts of 27μ medical grade alpha alumina can selectively remove stain and the organic plug and only affect a few microns of healthy enamel.[3] Far more healthy tooth structure is removed with a handpiece and the smallest diamond or bur, making it unsuitable as an instrument for evaluation. In addition, scanning electron microscopy studies clearly show microfracturing of the enamel surrounding handpiece preparation which is not present when a tooth is treated with microabrasion. The use of a handpiece also eliminates the evaluation phase being carried out by the dental hygienist. Patients are also much less intimidated by a gentle, silent burst of "sand" and air than by the dental handpiece.

Microabrasion Dentistry

When a pit or fissure has been determined to be carious, microabrasion is used to access and remove the decay. Short bursts of 27μ particles at 140 to 160 psi are used to carefully widen the groove. Because microabrasion cuts dentin more readily than enamel, the bursts are carefully directed to avoid creating an enamel ledge that can create difficulties in gaining access to the decay.

Once the access to the decay is established the power is reduced to 80 to 100 psi. This enables more controlled removal of the decay and is more comfortable to the patient. The extent of the decay is determined using one of the commercially available caries indicators. These are composed of propylene glycol with a die medium and only stain the irreversibly damaged outer caries.[12] Carious dentin is removed with short bursts of the 27μ particles. In using microabrasion, which removes decay and tooth structure on a much more controlled basis than a high-speed handpiece, it has been found that decay follows unusual paths, sometimes going laterally and then reversing course to proceed underneath seemingly unaffected dentin. The abrasive particles are directed to remove all areas of decay,

guided by repeated use of the caries indicator. Where teeth are substantially involved with soft caries, an excavator or low-speed handpiece may be necessary since microabrasive particles will embed in very soft decay without removing it.

The vast majority of teeth treated solely with microabrasion can be done without anesthesia. Patients feel either a tingling described as a mild "pins and needles" sensation experienced when a hand or foot "falls asleep" or nothing at all. The lack of discomfort, which might be expected when the dentin is subjected to the air stream or subsequent etching and rinsing has been attributed to the burnishing of the collagen matrix over the dentinal tubules.[13] This also increases the hybrid layer and may be involved in the dramatic increase in bond strength that has been reported when microabrasion is combined with acid etching.

Once all of the decay is removed, the teeth are treated with a fifth generation bonding material used according to the manufacturer's directions. The teeth can then be restored using one of the excellent composites available today. Many of the preparations done using microabrasion are so fine it was necessary to find a material that would be better suited to entering these areas. The new generation of flowable composites are a step in that direction, but a higher filler load is desirable.

Sealants

While the use of sealants have been found to be a beneficial preventive measure, there are definite contraindications in placing a sealant over decay, especially when the decay extends into dentin.[14] In *Modern Concepts in the Diagnosis and Treatment of Fissure Caries*, Patterson[15] noted that if shrinkage and marginal wear of the sealant produces leakage, the decay may not be detected before reaching the pulp; therefore, it is absolutely necessary that we thoroughly evaluate a fissure before placing a sealant.

The use of colored/opaque sealants further aggravates the problem of evaluation. Masking the progression of decay under these sealants often delays the diagnosis until substantial damage occurs (Figs. 4a, 4b). The same diagnostic approach should be applied prior to placing any sealant: Video diagnosis and microabrasion for evaluation of any stained or discolored fissures.

Discussion

A new "standard of care" is necessary in the diagnosis and treatment of caries in pits, fissures, and grooves. Although occlusal surfaces constitute only 12% of the total permanent dentition surface areas, they are the sites for the development of more than 50% of the caries reported among school-age children.[16] This decay has not been reduced by fluoride to the same extent as smooth-surface caries. In areas of fluoridated water, fissure caries accounted for 90% of the total caries detected.[17] The conclusion of the authors who reviewed the National Institute for Dental Research studies state that "the greatest caries susceptibility of both permanent and primary teeth is in the pit and fissure surfaces of the molars."[18] Adequately diagnosing these lesions can completely eliminate the "business" problem found in many offices.

Patients readily accept this new means of treatment. Explaining that we need to "look into" the grooves in the teeth prior to sealing them and that we can now attack decay much earlier and more conservatively than ever before is greatly appreciated. The ability to accomplish this without injections, pain, vibration, and noise is a tremendous benefit and a huge source of new patient referrals.

Summary

Conclusive research has called for the elimination of the explorer as a means of diagnosing pit and fissure caries. It has been shown to be not only unreliable, but capable of spreading caries and damaging enamel.[8,14] This technique, however, is still in use in most dental offices and is still taught in our dental schools. The well-intentioned placing of sealants on undiagnosed caries further exacerbates the problem.

New technology has provided the means for reliably and conservatively dealing with this problem. These new modalities should become the standard in diagnosis and treatment.

- Video examination of all pits, fissures, and grooves for changes in light transmission, color, or staining.
- Microabrasion of all suspect areas at low pressure with 27μ medical grade alpha alumina.
- Exposing and staining carious tooth structure with a propylene glycol caries indicator.
- Removal of decay using microabrasion.
- Restoration with a bonded composite.

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Dr. Ken Magid is cofounder and Vice President of Kinetic Instruments Inc., and has innovated and patented many products in dentistry. He is a consultant for various dental manufacturing companies on new products in the "high tech" area. Dr. Magid lectures nationwide and has given combined "hands on" clinics on high technology for cosmetic dentistry at many locations.

Dr. Magid has used his expertise in business and marketing to build a highly successful practice in Westchester County, NY. Dr. Magid provides a "cookbook" for using technology and modern marketing techniques to build a dynamic practice by turning "satisfied patients" into "referring patients."