Dentists must decide daily how to restore a cavitated tooth surface or replace a defective restoration. As part of that decision-making process, the method of preparation must be chosen. There are a growing number of dentists who routinely select the least invasive preparation technique possible. Minimally invasive dentistry (MID) is an evolving philosophy of care using the least invasion of hard or soft tissues with the latest technology. This article focuses on ways to prepare teeth that lead to conserving the maximum amount of healthy tissue, while providing a treatment outcome that patients value.

**MID Defined**

MID is defined by the World Congress of Minimally Invasive Dentistry as the evidence-based discipline dealing with oral hard and soft tissue-saving procedures, with the primary goal of improving quality of life through optimal oral health. For patients, MID means avoiding the use of needles and drills. MID aims to preserve as much tooth structure as possible and to eliminate the need to replace the restoration for as long as possible.

**Several Technology Choices for Cavity Preparation**

Smooth surface lesions and white-spot lesions can be remineralized by using a fluoride varnish. However, once cavitation of the enamel surface has occurred, surgical restoration is required. New cavitations are best documented with laser florescence (Figure 1), radiographs, and magnification. These lesions often can be restored without local anesthesia. Air abrasion (AA), hard tissue lasers, and electric high-speed handpieces coupled with diamond fissuration burs are 3 different technologies that can be used without local anesthesia.

Magnification is paramount in creating MID outcomes. Many dentists have added this aid for visualization, and the tendency is to increase the level of magnification with experience. For example, many dentists start with a binocular power of 2X and may increase to a 6X power. The ultimate in magnification is provided by an 8X to 20X microscope (Figure 2).

**Air Abrasion**

To prepare tooth structure for restorations, AA has been used very successfully for many.

---

**Authors**

Joe Whitehouse, MS, DDS
President
The World Congress of Minimally Invasive Dentistry
Private Practice
Castro Valley, California

V Kim Kutsch, DMD
Director
The World Congress of Minimally Invasive Dentistry
Private Practice
Albany, Oregon

Title photographs and dentistry by Douglas Terry, DDS, and Newton Fahl, Jr, DDS, MS.
years. Robert Black, DDS, first invented AA in 1947. It was very popular until the Borden air turbine handpiece was introduced in the late 1950s. AA can provide very conservative cavity preparations that are successfully restored with bonded resin restorations. Unfortunately, in the amalgam era its advantages were not fully appreciated. In the 1990s, with the advent of new generations of bondable materials, AA's potential was more fully realized.

AA does not require needles or drills, providing more comfortable dentistry for patients. Because AA does not vibrate the tooth and cuts enamel very well, it does not irritate the tooth to the extent that a handpiece/bur combination does using the traditional 557 carbide bur. AA, coupled from the extension-for-prevention philosophy of care, requires that much less tooth structure be removed to restore a localized cavitated lesion. Once the enamel preparation is adequate to reach the dentin, and because that dentin is nonvital tissue, extremely fine spoon excavators or even a small slow speed bur can be used to remove it. Bonding the restoration with composite resin completes the process. The smaller the restoration, the longer it may last.

Although the use of AA has diminished in the last few years, it remains a viable technology for conservative dentistry. Some dentists have expressed concern about the powder becoming airborne. By adding an external HEPA filter vacuum, the problem is virtually eliminated. Recently, to overcome this same concern about airborne powder in the operatory and to improve cutting efficiency, some manufacturers have added a parallel stream of water to the nozzle tip.

**Application of Air Abrasion**

AA can be used to prepare each of the 5 surfaces of a tooth. Possible preparations include GV Black Class 1, 3, 4, 5 and 6 (although modified to conserve healthy tooth structure) (Figure 3). For interproximal preparations for which a traditional GV Black Class II would be used, a tunnel preparation can be performed, either from the occlusal or the buccal surface. This conserves the marginal ridge and peripheral rim of enamel. Preserving marginal ridges may prevent possible cusp fractures in the future. AA also can be used to remove old composites.

Along with the benefits of no heat, friction, or vibration and a better surface to bond to, AA can be used for cleaning out crowns for recementation, resurfacing porcelain before
hydrofluoric acid application, surface preparation for bonding to old composites, and opening teeth for root canals, in particular cutting through porcelain on crowns to prevent breakage. With the use of a parallel stream AA system, amalgam can be removed (Figures 4 through 6).

**Laser Preparations**

With the advent of the Er,Cr:YSGG laser, teeth can be prepared without injections by using the laser to do the anesthetization first and the tooth preparation second.\(^{20,21}\) As with AA, the laser can prepare any tooth surface, all cavity classifications, and even crowns and veneers. In addition, it performs conservative soft tissue procedures like hemostasis, tissue retraction for impressions, gingivectomy, frenectomy, and even flapless crown lengthening. Laser dentists and practices are seeing high patient acceptance of this technology for dental care.\(^20\)

The Er,Cr:YSGG laser can be set to provide the correct energy for each surface to be treated, and in contrast to AA, the laser can remove the soft infected dentin efficiently. The prepared surface provides a better surface to bond to than a diamond bur preparation.\(^21\) However, with each technology the least amount of tooth structure can be removed, and the maximum amount of healthy tissue conserved. For example, Figure 7 shows an example of positioning the laser for preparing a tunnel preparation, and Figure 8 shows the completed tunnel preparations that preserve the peripheral rim/marginal ridges, removing interproximal decay that can be restored with a glass ionomer material.

To replace defective amalgam restorations, the Er,Cr:YSGG laser can be used to anesthetize the tooth.\(^{20,22}\) When the laser tip is placed approximately 10 mm from the surface of the tooth it provides adequate anesthesia to remove the amalgam with parallel water spray AA or a high-speed handpiece. Once the tooth is anesthetized, the amalgam can be easily removed with a sharp bur. Any residual decay and the completion of the cavity preparation can then be accomplished with the laser. This provides the patient with a needle-free, comfortable experience.

**Electric High-speed Handpiece Preparations**

Often when small areas of cavitation have occurred, very small carbide or diamond burs can be used to provide a conservative cavity preparation. Although this concept is not new,
the introduction of the fissurotomy bur allowed dentists to integrate MID into traditional high-speed handpiece preparations. Occlusal caries limited to the enamel or just beyond the dentoenamel junction usually can be removed with a minimum of sensitivity, especially if an electric high-speed handpiece is used. These instruments contribute less vibration and a smoother application of cutting activity. In addition to the fissurotomy bur, very small, pointed diamond burs provide an ideal preparation.

With the aid of new technological developments, an early minimally invasive approach to small cavitated lesions without the use of shots results in conservation of healthy tooth structure and less anxious patients. For many patients, success comes with the dentist having the ability to prepare and restore the tooth without the shot.

With a minimally invasive approach to cavity preparation, anesthesia, if needed, is administered with the laser. Then a high-speed handpiece can be used with an end-cutting bur to perform a tunnel preparation similar to AA or the laser. The restorative outcomes with glass ionomer are similar.

### Differences in Surfaces

When using an Er,CR:YSGG laser, it is important to note that laser-treated dentin surfaces do not accept caries indicator dye the same way as AA or bur preparations do. The laser-prepared surface has hundreds of microscopic grooves where dye can reside. Even after copious flushing there is the possibility of a false positive with caries detection dye on laser-treated surfaces. If a slow speed round bur or microspoon is used to remove the infected dentin, caries detection dye can be used with caution to identify the infected dentin.

### Restoration Choices

Patients are often anxious about undergoing dental procedures. Ideally, they prefer that any procedure is performed in a minimal time frame and that the restoration has maximum longevity. Choices for restorative materials include indirect materials and direct materials. Indirect materials, either laboratory fabricated composite, porcelain, or gold provide excellent restorations, but usually at higher costs. Computer aided design ≠ computer aided manufacturing technology offers the opportunity to provide single appointment indirect restorations of either composite or porcelain materials. Choices for direct restorations include amalgam, composite, and glass ionomer, or a combination of these materials. Amalgam is not indicated in minimally invasive preparations that are restoration-specific. For example, occlusal pit and fissure MID preparations may be extremely narrow and relatively deep compared with the width. A better material choice might be a resin-based composite or glass ionomer material placed into the depth of the preparation, followed by a veneer of microfilled composite.23

Although amalgam has a place in dentistry, it requires preparations that are designed specifically for the physical property requirements of the amalgam. These preparations often require the removal of healthy tooth structure that would not be removed with an alternate material choice. The composites and bonding agents now available provide longevity equal to amalgam without these drawbacks.24 Resin-ionomers, composites, and
preferably glass ionomers placed in non-stress-bearing areas provide the chemistry for remineralization. Combined with composite materials, they also can be very esthetic.

When restoring Class 2 preparations, the "sandwich technique" made popular by Graeme Milicich, BDS, of New Zealand, uses glass ionomer to replace the dentin and a composite to replace the enamel.25 The glass ionomer is placed at the floor of the gingival box to a level below the contact point, which is then covered by a thin layer of light curable resin-ionomer or flowable composite. The final composite layer is "sandwiched," or bonded, to the interface material. There are many benefits to this technique. It reduces the polymerization shrinkage stress on the cusps and provides a more optimal bond to the horizontal dentinal tubules that are parallel to the gingival box floor. It also provides a restoration with the advantages for remineralization.

Conclusion

Every patient would like to experience minimally invasive procedures that provide long-lasting and successful treatment outcomes. New technological advances can now improve dentists’ ability to detect dental caries at a very early stage (even before they appear on a radiograph), prepare the lesion for a restoration that is site specific to the tooth surface (prevention of extension), and restore it with an esthetic, bonded restoration that will be successful for a long time.

The current developments in AA—Er,Cr:YSGG lasers and small burs/diamonds enable dentists to routinely provide minimally invasive preparations without the need for local anesthesia.

For information about the 6th annual WCMID Conference, held August 18-20, 2005 in San Diego, CA, visit www.wcmid.com.

References