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The standards of dental care have evolved rapidly during the past 50 years. Today’s best practice modalities require both tooth conservation and clinical efficiency. These concepts are not always mutually compatible. The efficient and preferably rapid removal of existing tooth structures and restorative materials must be accomplished with minimal heat generation during the preparation phase.1

As clinical efficiency is increased with faster and more aggressive cutting tools (Fig. 1), it is clinically imperative that tooth preparation avoid the excessive heat generation that could possibly damage the remaining tooth structure and endanger the health of the pulp.2,3

In most clinical situations, water and air coolants are utilized in conjunction with high-speed bur preparation to reduce the risk of thermal damage to the tooth.3 The clinical efficiency of tooth preparation is largely dependant on the shape and design of the cutting bur, and the number of stops that comprise the overall treatment. The more often that the dentist must change burs during tooth cutting, the more time consuming the process and the less efficient the technique.

Practitioners use both visual and tactile clues to determine tissues to be removed. Darker dentin is assumed to be affected by caries; it should be removed (unless, of course, it is re-hardened secondary dentin). Lightly colored dentin and enamel are presumed to be healthy tissues. For the dentist to observe color differences during preparation, the bur’s rotation should remove debris as quickly and effectively as possible (Fig. 2).

The earliest dental burs were manufactured from a variety of metals that were harder than natural tooth structure. With time, steel became the preferred bur metal. Developments in particle-to-metal adhesion technology resulted in the first diamond burs. These burs were preferable for high-speed tooth preparation to steel.

The subsequent introduction of carbide cutting instruments was a leap forward for dentistry; carbide offered more effective tooth preparation with less surface striation than diamonds. More recently, crosscuts and innovative attack angles were introduced to the carbide cutting shank to make preparation better, faster and easier (Figs. 3a, b).

In the past, dentists have tended to favor diamond burs for extra-coronal tooth preparation while carbide burs have been used largely for intra-coronal cutting.2 The relative popularity of carbide and diamond burs varies considerably in various parts of the globe, largely due to local availability, cost and education.4

One factor that is often not considered by the clinician is that as diamond burs are used, their cutting efficiency tends to decrease dramatically. Their cutting diamonds tend to wear down and debris accumulates in the bur cavities (Fig. 4), reducing efficiency.5 In order to compensate, dentists tend to press harder on the tooth with the bur in order to maintain the earlier cutting efficiency. Inadvertently, this actually decreases the efficiency of the procedure and increases the potential for heat formation.

Diamond burs tend to grind tooth structures while carbide burs cut these same materials. This leads to the conclusion that crown and bridge preparation, where rapid and effective gross tooth reduction is required and desirable, is best accomplished with carbide instruments.

Recent research has indicated that when a crown or onlay restoration is to be bonded to the tooth surface, carbide bur preparation can improve the bond to the dentin.6 A more effectively bonded crown increases the longevity of the restoration by decreasing leakage, and thereby the possible adhesive failure of the restoration. Carbide burs typically generate a smoother surface and the partially visible smear layer.7

This smear layer may be more easily dissolved and incorporated by self-etching primers, thus providing a stronger hybrid layer. This results in higher bond strengths.8 Cross-cut carbide burs improve the retention of crowns cemented with zinc phosphate by approximately 50 percent. Thus, the use of finishing burs on axial walls is discouraged.9

Current concepts of conservative dentistry dictate that a minimum of healthy tooth structure be removed during the preparation prior to the restorative process. Natural enamel and dentin are very likely the best dental materials in existence. Tooth structure conservation is thus inherently a desirable dental objective.

Consequently, minimally invasive procedures that allow a greater part of the healthy tooth structure to be preserved are preferable (Fig. 5).10 The patient also benefits greatly from minimally invasive dentistry. There is typically less discomfort during treatment, and a greater likelihood that the repaired tooth will last a lifetime.

The dental profession tends to take burs for granted. They are frequently used for patient treatment every day, and their effectiveness and efficiency can have dramatic impact on the practice. It is interesting to note that if the practitioner uses burs that are just 10 percent more efficient, the savings in operative time can easily increase practice billing significantly.
without any corresponding increase in overhead. Thus, the entire revenue increase goes directly to the bottom line.

Generally, burs are one of the least expensive components of the dental armamentarium, at least relatively. A small difference in bur cost can often make a major clinical impact. The most important parameter to consider is to select the best bur for the job, keeping in mind that a small added expense of opting for a premium instrument can pay off handsomely.

Some burs are designed for single use. They can be sterilized and re-used, but often exhibit a significantly decreased cutting efficiency. Other burs are designed to be sterilized and re-used.

Recent research at the University of Rochester, Eastman Dental Center, jointly undertaken by the prosthodontic and the mechanical engineering departments, examined the efficiency of various dental burs with respect to cutting rate and load needed to complete standardized preparations in Macor samples. Both air-driven and electric handpieces were tested.

The cutting rate represents the speed at which the bur (reflecting its material composition and design) cuts through a standardized material. The faster the speed, the more efficient the preparation. The load measures the operator pressure needed to cut effectively. A higher required load will cause more operator fatigue at the end of a long working day.

In the air-driven high-speed handpiece, the SS White Great White Ultra (SS White Burs, Lakewood, N.J.) had a significantly greater cutting rate than the other burs tested (Fig. 6). In addition, the Great White Ultra bur required the least load, or operator pressure, for effective preparation (Fig. 7).

Similar results were observed for electric high-speed handpieces. The SS White Great White Ultra had a cutting rate significantly greater than the other burs tested (Fig. 8) and required the least load, or operator pressure, for effective preparation (Fig. 9).

In practical terms, the Great White Ultra burs cut between 11–35 percent faster than the other burs tested. This can save the practitioner between one to three minutes on a 10-minute preparation procedure. The decreased load translates into greater operator comfort.

Dental bur design has developed varying flute angle and cutting characteristics that are specific to the intended task. Operative, cavity and crown preparation carbide burs have flutes (dentates) that are designed deep and wide, creating a more aggressive cutting of enamel with increased speed and efficiency (Fig. 10). Operative burs are either straight bladed or crosscut. Straight-bladed burs cut more smoothly but are slower, particularly with harder substrates. Crosscut burs tend to cut faster, but may create more vibration. Finishing burs have more flutes, closer together and shallower, than operative instruments (Fig. 11). This design allows for fine finishing and polishing of dental materials or tooth surfaces.

The Great White Ultra bur is an...
because it does not “grab” or “catch” the substrate, and thus does not stall in harder materials. The novel design creates less stress on the remaining tooth structure and less frictional heat that may irritate the pulp and damage the supporting periodontal structures.

The aggressive cutting angle (Fig. 13) of the Great White Ultra allows the operator to use less pressure on the tooth during preparation (resulting in decreased tooth heating and dentist fatigue). The tightly controlled parameters of manufacturing quality control develop a high degree of concentricity in the Ultra burs that offers less vibration and chatter during use, and decreased maintenance costs for handpieces (Fig. 14).

The goals of conservative tooth preparation include:
1. Re-contouring the remaining tooth and restored structures to a specified shape and size to accommodate a crown.
2. Providing a depth guide on all surfaces, including the occlusal, to allow the crown to have sufficient bulk and strength to withstand occlusal and other intraoral forces.
3. Creating the intended marginal finish, whether shoulder or chamfer, at the same time as accomplishing the gross preparation of the other surfaces.
4. Developing a surface that is suitable for bonding the indirect restoration.
5. Remaining conservative of tooth structure.
6. Preparing the tooth quickly and efficiently for both patient and dentist comfort.

For most dentists, the cutting speed tops the list of features that are important in selecting dental burs. Carbide manufacturers have produced a variety of designs and shapes that are intended to reduce the time that it takes a practitioner to prepare the tooth for a crown.

The Great White Ultra bur cuts quickly and smoothly through enamel. It negotiates amalgam and other restorative materials with minimal clogging and no drag or stalling in these harder materials. The bulk reduction in the crown preparation phase can be accomplished with a single instrument (Fig. 15).

The highly dentated body of the Great White Ultra cuts efficiently and quickly, and combined with the smooth tip, helps to provide two reduction actions in one single pass with a single bur (Fig. 16). The rounded, non-crosscut tip provides smooth, precise and controlled margins with the same cutting motions as the gross preparation. Thus, the Great White Ultra is more efficient; there is less chair time.

There are two preferred marginal anatomies for crown preparation, the chamfer and the shoulder. Accordingly, two margin-specific clinical series of burs have been crafted. The Great White Ultra 856 Series develops a rounded axial-gingival margin providing a chamfer finish for the preparation (Fig. 17). The Great White Ultra 847 Series creates a 90 degree axial-gingival wall and provides a shoulder margin for crown restoration (Fig. 18). The Great White Ultras are available in a variety of diameters and cutting lengths.