Pulp exposures are not a common occurrence in dental practice. But when pulp tissue is exposed, the dentist must make some immediate decisions: whether to cap the pulp—and, if so, which material to use for pulp capping—or whether endodontics would be better treatment.

This subject has been loaded with confusion over the past several years as new techniques have been promoted and older concepts criticized. Many dentists are frustrated about which techniques to use and when to use them.

After completing a relatively thorough observation of current opinion and research on pulp capping, I have found that there is not a universally accepted procedure or concept for pulp capping. Many conflicting points of view exist and numerous techniques have demonstrated clinical success. This article discusses indications for pulp capping, various currently popular pulp-capping techniques and conclusions on pulp capping for 1998.

**WHEN TO CAP PULP TISSUE**

**Excessive bleeding or purulent discharge.** Every practitioner has accumulated empirical evidence about pulp-capping successes and failures. Most agree that attempting to cap a profusely bleeding or purulent pulp is futile. Excessive bleeding usually indicates a hyperemic pulp, with little or no chance of painless recovery or long-term service. If clinical success is expected, bleeding from exposed pulp tissue should be minimal, and it should stop soon after the exposure. Any purulent discharge from the pulp chamber indicates a nonvital pulp that will not respond successfully to any pulp-capping procedure.

**Dental caries activity.** Pulp tissue in grossly carious teeth has been traumatized significantly by the continually increasing size of the carious lesion, and by the microorganisms and debris present in the carious lesion. Carious pulp exposures are almost certainly loaded with microorganisms. It is also difficult to remove soft dentin atraumatically when it is directly adjacent to pulp tissue.

Large carious lesions require significant tooth structure removal and potential major exposures of pulp tissue. It is impossible to know if such pulp exposures will respond positively or negatively to pulp capping. Often, pulp capping is attempted to avoid the cost of endodontic therapy. Patients with large pulp exposures should be warned that when pulp capping is attempted, long-term success is certainly less predictable than when pulp exposures are small or noncarious.

**Mechanical pulp exposures.** Pulp tissue location is usually predictable in most teeth, but occasionally atypical anatomical variations are found, and even the most careful clinicians can expose pulps accidentally. Occasionally, a practitioner nicks pulp tissue with a rotary instrument while cutting the tooth preparation, and these "mechanical" pulp ex-
postures have a good prognosis if capped adequately. Mechanical pulp exposures are usually small (less than 0.5 millimeter), and they bleed only slightly. Mechanical exposures are good candidates for pulp capping.

**TYPE OF RESTORATION PLANNED FOR THE EXPOSED PULP**

Deep carious lesions. Deep carious lesions in adolescents who have large dental pulps are usually restored with amalgam or composite restorations. These restorations are easy to restore or to re-restore. Therefore, gambling with pulp capping is probably indicated in situations where inexpensive intracoronal restorations are planned as the final restorations.

If relatively expensive crown restorations are planned for the final treatment, pulp capping is a gamble of significance. Endodontic therapy success is predictable at the 95 percent level, but pulp capping is far less predictable. Endodontic therapy is probably indicated when crowns or fixed partial dentures are planned as final restorations on the pulp-capped tooth.

Small carious pulp exposures. Empirically observed success by dentists supports the idea that even small (less than or equal to 0.5 mm) pulp exposures. However, if small carious pulp exposures are present in teeth planned for crowns or fixed partial dentures, endodontic treatment—instead of pulp capping—is probably in order.

**WHEN HAVE YOU REMOVED ENOUGH OF THE CARIOUS LESION?**

Staining carious lesions was proposed many years ago by Fusayama to allow differentiation of remineralizable and non-remineralizable dentin. Use of caries stains has increased in popularity over the last several years as it has been popularized by numerous speakers. When tooth preparations approach the pulp, use of caries staining liquid is indicated. Example brands are Cari-D-Tect (Gresco Products Inc.), Caries Detector (J Morita USA Inc.), Caries Finder (Danville Engineering) and Sable Seek (Ultradent Products). These harmless dyes demonstrate nonmineralizable dentin. Parts of the tooth that stain should be removed. Any tooth structure that does not stain can remain.

Pulp capping is more appropriate in teeth for which intracoronal restorations and not crowns are planned.

It is interesting to note that, as demonstrated both clinically and in closely controlled research, some clinically soft dentin will remineralize. For years, many dentists have taken away too much soft dentin, some of which would remineralize.

**POPULAR PULP-CAPPING TECHNIQUES**

**Calcium hydroxide pastes.** Although maligned by several speakers, calcium hydroxide, or Ca(OH)₂, pastes—such as Dycal (Caulk Dentsply) and Life (Kerr Corp.)—still share a major portion of the market for pulp capping. Recent animal research by long-time, well-known pulp researchers showed that in subhuman primates, Ca(OH)₂ paste was more successful than bonding agents on vital pulp exposures. Those who support the use of bonding agents for pulp capping have data that disagree with the previously stated research, and the controversy continues. Experienced practitioners have observed the relative success of Ca(OH)₂ pastes over 30 years, but are there better ways to cap an exposed pulp?

**Bonding agents.** In recent years, research has supported using resin bonding agents on potentially healable exposed pulps. Clinical success has been observed using numerous bonding brands, including All-Bond 2 (Bisco Dental Products) and Optibond (Kerr Corp.). Great controversy has arisen as clinicians have promoted the acid etching of exposed pulps followed by placement of bonding chemicals. After significant research, numerous U.S. dental schools are supporting and teaching these procedures.

**4-META bonding agent.** Studies have supported using 4-methacryloyloxyethyl trimellitate anhydride, or 4-META, bond (Amalgambond, Parkell) on exposed pulp. Again, success has been observed by clinicians and researchers. Experienced clinicians know the high level of tooth desensitization afforded by Amalgambond and C & B-Metabond (Parkell), both of which are 4-META.

**CONCLUSION**

Why there is controversy and high emotion over pulp-capping agents amazes me. All of the procedures described above have demonstrated success and are used daily by practitioners.
However, that having been said, pulp capping should be attempted only when small pulp exposures without excessive bleeding or purulent discharge are present. Pulp capping is more appropriate in teeth for which intracoronal restorations and not crowns are planned. Exposed pulps on teeth planned to receive single crowns or to serve as fixed-partial-denture abutments probably should receive endodontic therapy when pulps are exposed. Numerous pulp capping techniques, including the use of Ca(OH)$_2$ pastes, have been successful historically, but newer techniques using resin bonding agents or 4-META bonding agents have also demonstrated success and are leading in popularity among dentists.

The views expressed are those of the author and do not necessarily reflect the opinions or official policies of the American Dental Association.

Educational information on topics discussed by Dr. Christensen in this article is available through Practical Clinical Courses and can be obtained by calling 1-800-223-6569.