Almost no procedure in dentistry has undergone more evolution both in philosophy and clinical practice than the restoration of badly broken down vital and non-vital teeth. The issues surrounding this topic include post vs. no post, adhesive cements vs. traditional post cements, adhesive technique, core materials, and technique sensitivity in core placement. Within the adhesive technique category, there are a multitude of issues to consider, including mode of cure, compatibility of adhesives and core material, phosphoric acid etch vs. self-etch products, and contamination with sulcular fluids or other agents.

Research and technology have revolutionized dental procedures. This revolution has occurred at such a staggering rate, it has become almost overwhelming to the practicing dentist, who must make decisions based on a combination of experience and current trends. This article will combine the results of current research and clinical experience to provide answers to the many questions that have arisen over the last several years regarding restoration of severely broken down teeth.

The Use of Posts in Non-Vital Teeth

The philosophy of the post and core restoration has changed significantly over the past 20 years. Research has shown that posts do not strengthen teeth and should only be used to retain the core build-up.1,2 Because core build up material can now be adhesively bonded to tooth structure, many clinicians choose not to use posts more frequently than in years past. However, in severely broken down teeth, posts are still used to aid in core retention. Modern prefabricated post materials can consist of stainless steel, titanium, ceramic, or fiber-reinforced composite.4,5 Some of the newer post designs have been created to more intimately conform to the anatomy of the canal. Many brands are parallel-sided, but tapered at the apical end, or are tapered in shape. Tapered posts have been shown to fit the canal shape more closely, and be safer at the apical end, but have also been shown to create a wedge effect which can result in vertical root fractures.2,3 Stiffness of posts has also become an issue studied recently. The properties of metal, ceramic and resin posts are quite different. It has been shown that the resin-reinforced posts have approximately the same stiffness, or modulus of elasticity, as dentin. The other types of posts are much stiffer than dentin. Therefore, fiber-resin posts may be less likely to cause root fracture than other post materials.6

Therefore, fiber-resin posts may be less likely to cause root fracture than other post materials.6

Adhesive versus Traditional Cements

There are different goals practitioners have regarding post cementation. Retrievability is one philosophy in post placement. Some practitioners feel more comfortable being able to re-access the canal.
at a later time, if necessary. However, studies have shown endodontic success rates to be as high as 90 - 95%. With the quality of endodontic materials and the high success rate of root canal treatments done today, it is very rare that one would need to gain access to an obturated canal. Moreover, most final crown restorations eventually fail because of post and core failures and/or lack of post retention, not because of failure of the endodontic procedure. However, if the goal of the practitioner is post retrievability, zinc phosphate cement is still an excellent post cement. Adequate working time and low film thickness are also advantages of this type of cement. However, zinc phosphate does not bond to tooth structure.

Glass ionomer (GI) cements can also be used to cement posts. Conventional GI cements release fluoride and have a minimal bond to tooth structure. Resin-modified glass ionomer cements are used most commonly for traditional cementation methods. This cement has a fairly high bond to tooth structure and still releases fluoride, although not to the degree that the conventional GI cements do. However, there has been a problem in the past with delayed expansion, which could be a problem cementing a post in a narrow, enclosed canal space. Most companies state that this problem has been resolved, however.

If the goal in post cementation is to strengthen teeth, there are adhesive cements available that can bond to all types of post materials as well as to dentin. The theory that posts do not bond to dentin, such as moisture conditions, dentin depth, curing mode, chemical formulation, and contamination with blood, saliva and astringents, has been much discussion in the literature relating to adhesive dentistry for the best adhesive techniques.

**Core Materials**

Two of the most critical issues regarding the choice of an ideal core material are retention and strength. The core build-up must be retentive enough short-term to resist dislodgement forces during the preparation and impression-making phase and long-term, after the final restoration is completed. Retention of core material to tooth structure can be obtained by developing undercuts in the preparation, or by bonding to tooth structure, or by a combination of both. It is always best not to depend solely on bond strength, because there are so many factors which affect the bond of composite to dentin, such as moisture tolerance, contamination, and adhesive/core material compatibility. There has been much discussion in the literature relating to adhesive dentistry for the best adhesive techniques.

**TABLE 1**

<table>
<thead>
<tr>
<th>Post Material</th>
<th>Esthetic Resin Cement†</th>
<th>Adhesive Resin Cement†</th>
<th>Panavia 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>16.4 (9.5)</td>
<td>27.3 (4.6)</td>
<td>29.9 (11.0)</td>
</tr>
<tr>
<td>Titanium</td>
<td>11.7 (2.7)</td>
<td>22.0 (2.0)</td>
<td>36.9 (11.7)</td>
</tr>
<tr>
<td>Carbon Fiber</td>
<td>13.7 (5.0)</td>
<td>20.0 (3.1)</td>
<td>24.5 (0.9)</td>
</tr>
<tr>
<td>Zirconium Ceramic A</td>
<td>8.2 (2.7)</td>
<td>7.4 (3.0)</td>
<td>21.7 (8.0)</td>
</tr>
<tr>
<td>Zirconium Ceramic B</td>
<td>7.6 (2.0)</td>
<td>12.8 (5.8)</td>
<td>31.6 (10.2)</td>
</tr>
</tbody>
</table>

*Reprinted with permission from Quintessence Publishing Co. †Brand names available upon request

**TABLE 2**

<table>
<thead>
<tr>
<th>Core Material</th>
<th>Dual-Cured Core Material†</th>
<th>Self-Cured Core Material†</th>
<th>Clearfil Photo Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearfil SE Bond</td>
<td>41.0 (5.9)</td>
<td>20.4 (8.1)</td>
<td>35.9 (7.4)</td>
</tr>
<tr>
<td>Dual-Cured</td>
<td>26.7 (7.6)</td>
<td>0.0</td>
<td>23.0 (5.9)</td>
</tr>
</tbody>
</table>

*Reprinted with permission from Quintessence Publishing Co. †Brand names available upon request

The newest generation of adhesives, the self-etching types, contain an acidic monomer that etches and primes dentin simultaneously, thus eliminating the need for phosphoric acid etching. These products are less technique-sensitive because of the fewer steps involved. They also have been shown to produce less post-operative sensitivity because of the simultaneous demineralization and resin penetration of dentinal tubules, which prevents a layer of demineralized dentin from forming below the adhesive layer. Also, self-etching adhesives potentially bond better to deep dentin because they precipitate smear layers which keep the large, wet tubules of deep dentin from being exposed. Research has shown some self-etching products provide excellent bond strengths to dentin. Total-etch systems are still excellent adhesives, but the future of dentin bonding will be with the self-etching systems. When bonding with core materials, it is best to follow manufacturers’ instructions and read current publications on adhesive dentistry for the best adhesive techniques.
adhesive/core compatibility. Many core materials are dual- or self-cured and may not adhere adequately to a light-cured or a dual-cured adhesive. Recently, an article has been published that supports this contention. In this study, a self-etched, light-cured adhesive and a dual-cured, total-etch adhesive were bonded with light-, dual-, and self-cured core materials to superficial dentin. The results showed that there were some incompatibilities. However, although Clearfil SE Bond is indicated primarily for bonding to light-cured resins, in this study, it was compatible with all types of core materials, as shown in Table 2.

Figures 1, 2 (reprinted with permission from Quintessence Publishing Co.) and 3 show the adhesive interface of several of the groups in this study. Note that in Figure 1, the resin tags are longer and more numerous than those shown in Figure 2. However, the bond strength of the group represented by Figure 1 was lower (26.7 MPa) than the group represented by Figure 2 (41.0 MPa). Resin tag quantity and quality do not necessarily relate to bond strength. Figure 3 is an example of a bonding incompatibility.

Other recent articles have shown that there are less incompatibilities now than there were several years ago between adhesives and core materials, but in general, highest bond strengths were obtained with light-cured core materials.

Core material strength is the other critical issue in obtaining a successful, long-term restoration. Many studies have shown that amalgam and composite are the two strongest build-up materials available. Because of the ability to bond to tooth structure and the immediate setting capacity, composite is the material of choice in today’s dental offices. There are many composite build-up materials available. Most composite core materials are either dual- or self-cured because often, the restorations are thick and chemical-curing capability is an advantage. However, in general, dual- and self-cured composites have been shown to have lower bond strengths to dentin than light-cured products.

Clearfil Photo Core, one of the only light-cured core materials on the market, is very translucent in color and has a very high depth of cure. One study cured 2, 4, 6, and 10 mm of Clearfil Photo Core to dentin with the adhesive Clearfil SE Bond. The results, shown in Table 3, showed that bond strength did not decrease at all with Clearfil Photo Core until the 10 mm thick group, and even at 10 mm, the bond strength was greater than 18 MPa, a clinically acceptable bond. Therefore, these results suggest that it is possible to use a light-cured core material without compromising strength.

**Technique Sensitivity in Core Placement**

Often, when restoring badly broken down teeth, it is necessary for the preparation to extend subgingivally, which tends to cause trauma to the soft tissues. One disadvantage of composite core material is the technique sensitivity issue involved in the bonding process. It is always advisable to use rubber dam isolation whenever possible in any bonding situation. Recent studies have reported on the results of various types of contamination on the bond strength of composite to dentin, with varying results. Most studies used one- or two-bottle total-etch systems, rather than self-etching systems. To summarize the results of several studies, saliva did not appear to affect the bond strength of total-etch adhesives to tooth structure, but blood, handpiece oil, and eugenol lowered bond strengths. However, reetching with phosphoric acid seemed to raise the bond strengths to nearly control levels.

The results of our recent saliva contamination study using Clearfil SE Bond adhesive and Clearfil AP-X composite bonded to human dentin are shown in Table 4. The results indicated that saliva did not negatively affect the bonding process, whether contamination occurred before or during adhesive placement.

A similar study using the same adhesive and composite showed that contamination with blood also did not affect the bond strength significantly, which differed from previous studies. However, in yet another contamination study with astringents, we found that both ferric sulfate and aluminum chloride astringents negatively affected the bond strength of composite to dentin. Although it was found that rinsing with water spray restored bond strengths to half or more than half of the original bond, both astringents had a negative affect on the bond strength of total-etch adhesives to tooth structure, but blood, handpiece oil, and eugenol lowered bond strengths. However, re-etching with phosphoric acid seemed to raise the bond strengths to nearly control levels.

**TABLE 3**

<table>
<thead>
<tr>
<th>Core Material†</th>
<th>2 mm</th>
<th>4 mm</th>
<th>6 mm</th>
<th>10 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearfil Photo Core</td>
<td>25.9 (6.8)</td>
<td>24.5 (5.2)</td>
<td>26.3 (6.8)</td>
<td>18.9 (7.6)</td>
</tr>
<tr>
<td>Dual-Cured Core Material†</td>
<td>19.3 (3.2)</td>
<td>23.1 (7.6)</td>
<td>24.2 (4.0)</td>
<td>15.4 (4.1)</td>
</tr>
<tr>
<td>Self-Cured Core Material†</td>
<td>14.3 (2.4)</td>
<td>20.9 (2.2)</td>
<td>16.2 (3.9)</td>
<td>14.9 (3.7)</td>
</tr>
</tbody>
</table>

†Brand names available upon request

**TABLE 4**

<table>
<thead>
<tr>
<th>Control</th>
<th>SA*</th>
<th>AS*</th>
<th>ASW*</th>
<th>ASWA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.1 (7.6)</td>
<td>30.8 (7.1)</td>
<td>25.1 (9.6)</td>
<td>25.6 (8.2)</td>
<td>31.2 (7.4)</td>
</tr>
</tbody>
</table>

*SA = Saliva, Adhesive AS = Adhesive, Saliva ASW = Adhesive, Saliva, Water rinse ASWA = Adhesive, Saliva, Water rinse, Re-apply Adhesive (continued on page 4)
to dentin. Therefore, it may be desirable to try to achieve tissue stability without the use of astringents, if possible. Dry retraction cord, or other types of tissue retraction methods may need to be explored when bonding composite core materials.

**Clinical Technique**

This case describes the technique for creating a bonded core build-up for a vital tooth. In Figure 4, the pre-operative view shows the buccal cusp of tooth #4 fractured off to the level of the gingival tissue. After the rubber dam was placed (Figures 5 and 6), the rest of the old restoration was removed. Figure 7 shows the remaining tooth structure after all caries and old composite were removed. Next, a core former was trimmed and fit to the remaining tooth structure (Figures 8 and 9). Once a correct fit was verified, dry retraction cord was placed and Clearfil SE Bond Primer and adhesive were applied to the rinsed and gently dried tooth structure (Figures 8 and 9). Clearfil Photo Core was light-cured for 10 seconds (Figures 8 and 9). According to manufacturer’s instructions, and the adhesive was rinsed and gently dried tooth structure (Figures 8 and 9). The core build-up for a vital tooth. In

References


Rapid Core Buildup Technique

necessary. While the purpose of a post is to help retain the core, complete elimination of the post is an area that still requires further investigation. In one study, it was shown that core buildups with a post exhibited statistically better strength than similar size core buildups without a post. If any doubt exists as to whether a post is necessary, placing a post in a non-vital tooth is the prudent alternative.

Prior to the advent of the bonding revolution and adhesive dentistry, amalgam cores with pins were commonly used for core buildups on vital teeth. An alternate technique in some cases was elective devitalization of the tooth and placement of a cast post and core. With adhesive dentistry having advanced to the point where bonding to dentin is predictable and successful, it is possible to secure a composite core to dentin without the use of pins.

In the case of vital teeth, a core buildup may often be done without the need for elective endodontics so long as there is some coronal tooth structure left. With adhesive procedures and composite, it is inappropriate to use pins to help retain the core. Composite has adequate strength for most situations. It can be tooth colored or shaded for contrast to tooth structure, and most composites cut like dentin. Composite materials can also be prepared immediately after curing.

This article will demonstrate a rapid core buildup technique using a self-etching primer/bonding system and a compatible light cured material. The manufacturer suggests a large volume of material may be light cured in bulk. While there is always a concern with regard to possible microleakage from polymerization shrinkage, especially

Chairside Technique

All defective restorations and caries were removed from teeth using a KaVo Optilux fiberoptic #649B high speed handpiece (KaVo America). Figure 1 shows the completed excavations. A matrix system of the clinician’s choice is then placed. In this case, conventional Tofflemire bands and retainers were used. The matrices are secured at the gingival margin with anatomic wooden wedges (either Contoured Wood Wedges; Clinician’s Choice or Sycamore Wood Wedges; Premier). (Figure 2) The cavity preparation is washed well and dried.

Using a microbrush (Microbrush Corporation), Clearfil SE Bond self-etching primer (Kuraray) was applied and gently agitated on the tooth surface for 20 seconds. (Figure 4) It was then gently air dried to evaporate any excess solvent. Using another microbrush the bonding agent was applied, air thinned gently, and light cured for 10 seconds. (Figure 5) It is a good idea to always use different color brushes for primer and bond so as not to confuse the two brushes.

After the adhesive was applied, Photo-Core (Kuraray), a light cured core buildup material was inserted into the cavities. This material is easily condensed and will have good adaptation to the underlying dentin. According to the manufacturer, a layer of up to 8mm can be cured, thereby obviating the need for incremental buildup unless the amount of core material is going to be greater than 8mm in height.

The matrices were opened and the core cured for another 20 seconds from the facial. Curing can also be done from the palatal or lingual where the bands are completely removed. (Figure 6) After removal of the matrices, the teeth were ready to be prepared for crowns. (Figure 7) Impressions and temporization followed.

There are many ways to accomplish a core buildup on vital teeth. This article offers the clinician an additional technique to rapidly and predictably accomplish the task.

REFERENCES
D2950 core buildup, including any pins

Refers to building up of anatomical crown when restorative crown will be placed, whether or not pins are used.

Limoli Comments:
A core buildup is frequently called a “crown buildup” by the reimbursement industry, even though terminology was changed from “crown buildup” to “core buildup” in the 1991 CDT-1. Its clinical definition is quite clear since it essentially is a constructed foundation upon which a crown is to be seated.

A core buildup is necessary only when the tooth being crowned is so damaged that there is insufficient sound tooth structure remaining to support a restorative crown. According to some reimbursement contracts, liability acceptance for core buildups must clinically involve the remaining compromised clinical crown, which would generally be 3 mm or less in height circumferentially. From the standpoint of the dynamics of occlusion, adequate mechanical retention is required to withstand the displacement of the fabricated crown.

A core crown buildup would be necessary to furnish required retention form or resistance form. Any procedure involving tooth structure replacement for purposes of pulpal insulation, undercut elimination, casting bulk reduction, or for any purpose other than obtaining adequate retention would not qualify as a buildup.

However, it seems prudent to supplement the core retention provided by an endodontic post if more than 50% of the coronal tooth structure has been lost. The core buildup reimbursement criterion is an ongoing controversy. Remaining clinical structures of 3 mm or less circumferentially do not correspond to less than 50% of remaining, sound, natural tooth structure.

A core buildup may or may not contain pins. If pins are associated with the core buildup, they are all-inclusive in the buildup procedure. The pins that are used should not be identified separately. Your fee for a core buildup should be the same whether or not pins are used.

Many reimbursement contracts consider core buildups on vital teeth to be no more than cement bases. Traditionally, payers do not reimburse providers for cavity liners or cement bases. It is most beneficial to submit code D2950 with a narrative report to avoid reimbursement confusion. The narrative for code D2950 should indicate whether the tooth is vital.

In most cases, core buildups are an allowed benefit if the radiographic and photographic evidences substantiate treatment need and if the procedure is not specifically excluded from coverage. Claims for buildups that are not submitted with the crown’s insertion date are either denied, pending submission of the crown, or are reviewed by a dental consultant for liability evaluation.

Claims examiners routinely deny benefits for core buildups because the claims are not submitted with x-rays, photos, or narratives. Most third-party payers agree that the burden of proof for a buildup procedure lies with the submitting dental office. It is a sad fact that most payers find core buildups being billed simply to increase the benefit payable for the crown.

A sample narrative may be:
“Provides needed resistance, retention and geometric form to compromised coronal aspect of tooth. See enclosed photograph.”
I have been using caries disclosing solutions (Caries Detector from Kuraray) for several years and was wondering if the use of such materials has any affect on bond strength to dentin?

A study published in Operative Dentistry, 27:238-242, 2002, by R.B. Kazeni, et.al, indicated that there was no significant affect on bond strength with the two caries disclosing materials tested with the three bonding agents tested. The project studied the effect of caries disclosing dyes on the bond strength to dentin of Clearfil SE Bond, Prompt L-Pop, and Prime & Bond. Self-etching primer products are rapidly replacing “total-etch” and “acid-etch” systems and the use of caries dye products is also increasing. Clearfil SE Bond, one of the self-etching products studied in this project has become one of the most recognized, tested, and popular of the self-etching primers.

What is the best cement to use for post cementation?

A study published in the Journal of Prosthodontics, 11:168-175, 2002, by M.S. Hagge et. Al., reported that Panavia 21 resin cement had the highest retentive strength of the five cements tested. Parapost posts were cemented with a composite material (Parapost composite), a zinc phosphate (Flecks), a glass ionomer (Ketac-Cem), a 4-META resin (C&B Metabond), and a resin cement (Panavia 21), then tested. The retentive strength reported for Panavia 21 was consistently and significantly higher than any of the other cements in this study.

PANAVIA F is a dual-cure adhesive resin cement that releases fluoride and bonds directly to cut enamel, dentin, composite, porcelain and base-, semi-precious and precious metals. PANAVIA F is especially developed for use with metal & porcelain inlays and onlays, crowns, bridges and adhesive splints. With ED PRIMER an effective and mild one-step conditioning of cut enamel and dentine is ensured, so that there is no need for acid etching. The anaerobic polymerization property of PANAVIA F provides convenient working and setting times. PANAVIA F is indicated for an extensive range of indications and is available in three shades: TC, WHITE and OPAQUE.

CARIES DETECTOR is an excellent caries disclosing agent for conservative dentistry. It aids in the excavation of the outer decalcified and infected carious dentin layer, permitting optimal caries removal. It also helps minimize the removal of remineralizable, healthy dentin, protecting the vitality of the pulp and, as a result, conserve maximal amount of healthy tissue.

Clearfil SE Bond is a very simple to use, light-cure bonding system using a water-based, pulp friendly primer. Post-operative sensitivity is virtually eliminated along with the significantly reduced procedural time. Predictable, dependable results are the norm due to the legendary bond strength along with almost no microleakage. The convenient “Inteli-Case” assures consistent dispensing as well as avoiding any risk of contact dermatological irritations. The clinical indications are: direct restorations using any light cure composite, under amalgam restorations, as a cavity sealing pre-treatment for indirect restorations, and as a treatment for most root surface sensitivity, including immediately after scaling and root planning. Order the convenient kit today and experience why SE Bond is the number one choice for any bonding application.
The demand for esthetic restorative procedures continues to increase almost geometrically. Kuraray Dental, the company responsible for many of the epoch-making advances in adhesive resin products, proudly expands our product offering with yet another product solution for your restorative treatment procedures—Clearfil PhotoCore.

Clearfil PhotoCore is the logical product for dependable, strong, enduring, and fast core build-ups. Our “PANAVIA” series is the standard-of-care for adhesive cementation, our bonding agents included in the “CLEARFIL” Series, Clearfil SE Bond and Liner Bond 2V, are rapidly becoming Number 1, as well as the standard-of-care for self-etching bonding systems. Now there’s a strong, reliable solution for all your core build-up needs, including cores for vital and endodontically treated teeth. Clearfil PhotoCore. When used with Clearfil SE Bond, Clearfil PhotoCore has the following compelling features:

• Self-etching technology
• Exceptional bond strength and durability
• 8 mm/40 sec single increment depth of cure
• Cost effective and very easy to use
• Cuts and feels like dentin

Clearfil PhotoCore was awarded the 2003 Reality’s Choice Five Star Award.