A cement is a material that relates two or more materials so that they stay together in a specific relationship, incorporated as if they were a single unit. In dentistry, we have a variety of cementation materials, some of which have been used for many decades, and others which have just recently been developed.

The more traditional, older, cements were luting materials that relied on mechanical retention such as long axial walls, taper, and precise fit. These conventional cements filled the gap between the restoration and the tooth, and nothing more. The newer, adhesive cements stabilize the entire system of components by adhesively bonding to both the restoration and the tooth. Adhesive cements bond the gap between the restoration and the tooth, creating a monobloc. The adhesive cements have additional required properties; they must also be functional, color-matched, and bio-compatible.

The choice of cement is defined by the procedure and the materials that are involved; no one cement is necessarily ideal for all purposes. The selection of a particular cement in the dental practice should be based on the strength, reliability, predictability, aesthetics, and most importantly, ease-of-use. Over the past decade, adhesive resin cements have become increasingly popular among dentists. After all, resin cements bond to enamel and dentin, and develop micromechanical attachments to restorative metals and ceramics. On the other hand, zinc phosphate and polycarboxylate cements have no adhesion or condensation, otherwise known as “System B” obturation (Figure 15). In addition, for canal lubrication as well as pulpal emulsification in vital cases, an EDTA gel EndoEze is employed (Ultradent, South Jordan, Utah, USA) (Figure 14). Aside from this, Global microscopes (Global Surgical, St. Louis, MO, USA) are used for superior visualization of the root canal system (Figures 15–17). While its beyond the scope of this individual column, the visualization afforded by the surgical microscope is simply astounding. There is no adequate substitute for the magnification, lighting and intimate view of the tooth in progress as is attainable through the surgical operating microscope. As an adjunct during clinical procedures to help determine working length, the Elements Diagnostic Unit (Sylvania, Orange, CA, USA) is used as an electronic apex locator (Figure 16) as well as digital radiography (Schick Technologies, Long Island City, New York, New York, USA) (Figure 19). For treatment of coronal seal as a build up for crowns after bonded obturation with RealSeal, Core Paste (DemMat, Santa Maria, CA, USA) (Figure 20) build up material is favored. Subsequent columns will explain the rationale for utilizing these particular brands and techniques in detail. In addition, as mentioned, the above recommendations notwithstanding, excellent clinical results can be achieved with a variety of techniques and methods with sound principles guiding the hand of the clinician who employs them. This said, the author has empirically found the mixture of these products, materials and techniques to provide the most effective and efficient and ergonomic armamentarium to achieve treatment goals of the many materials used and tested (Figure 21).

In Part 2 of this 6 part series, a specific regimen for canal instrumentation will be provided. Part 3 will provide a similar description for obturation. Part 4 will discuss irrigation protocols. Part 5 will address modern retreatment possibilities. Part 6 will address case selection and diagnostic considerations and treatment planning. Throughout the series, emphasis will be placed upon principles in lieu of product recommendations bearing in mind that many controversies exist with regard to the most ideal techniques and protocols for clinical Endodontic treatment. I welcome your feedback and questions.

The author would like to thank Dr. Arnaldo Castellucci, Dr. Gary Carr, PERF, EIE2 and the Digital Office for Endodontists for the images in Figures 1, 2, 5, 15, 17. The author would also like to thank Dr. Martin Trope for the images in Figures 9–12.

The author would like to thank Dr. Richard Mounce is in private Endodontic practice in Portland, Oregon, U.S.A. Dr. Mounce is widely published and lectures worldwide. He is the author of a comprehensive DVD on cleansing, shaping and obturating the root canal system. For more information on the DVD or to contact Dr. Mounce, please send an e-mail to: Comfort@MounceEndo.com.

### Simplified Adhesive Cementation... What, Where and How

George Freedman, Canada

<table>
<thead>
<tr>
<th>Material</th>
<th>Preparation</th>
<th>Crown Preparation</th>
<th>Crown Seating</th>
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</thead>
<tbody>
<tr>
<td>Embrace WetBond Universal Cement (Pulpdent)</td>
<td>1. rinse tooth and leave moist surface</td>
<td>1. automic cement directly into coping</td>
<td>1. place crown onto preparation</td>
</tr>
<tr>
<td>Panavia F2.0 (Kuraray)</td>
<td>1. rinse and damp dry</td>
<td>1. apply the metal primer</td>
<td>1. place crown onto preparation</td>
</tr>
<tr>
<td>Relux Unicorn (SM ESPE)</td>
<td>1. mix primer and apply to tooth</td>
<td>2. place base and catalyst onto mixing pad</td>
<td>1. place crown onto preparation</td>
</tr>
<tr>
<td></td>
<td>5. wait 50 seconds</td>
<td>3. mix cement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. load cement into coping</td>
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Figure 1a. Rinse and leave moist.  
Figure 1b. Mesiobuccal view to reveal three canals.  
Figure 1c. Place crown onto preparation.  
Figure 1d. Clinical case performed with the materials and products described.
The number of steps typically involved in the cementation procedure, and the associated clinical challenges that are involved in the chairside application of a long and complex restorative protocol.

Ideally, a cement should function simply and effectively by adhering to all dental and restorative surfaces (enamel and dentin, metal and porcelain). It should involve little or no technique sensitivity (such as chairside mixing, multiple sequential layer applications, drying or wetting requirements, or a long self-cure setting time). Cementation should be easily performed by the dentist and the assistant, or the dentist alone.

There are three major categories of resin cements, and they are distinguished by their curing mode.

Light-cure cements are typically used for thin metal-free restorations such as porcelain veneers, and metal-free orthodontic retainers and periodontal splints. For these cements, it is essential that the curing light reach every part of the adhesive in order to assure polymerization; if the resin is too deep, or the ceramic too thick, and not enough light reaches the photoinitiators, the luting material will not set completely. Ultimately, the bonding and restorative failure are the result.

Dual-cure resin cements can be used for metal free inlays, onlays, crowns and bridges, and endodontic posts. These cements are not reactive to light, and polymerize by chemical reaction only when the separate components are physically mixed together.

Some of the important parameters that should be considered in the selection of resin cement are:

- **Film thickness** This is a measure of the minimum thickness that a particular product can assume under loading and functional pressure while maintaining its strength and other properties. Most resin cements have film thicknesses from 10-50 µ. It may seem at first glance that this could hinder the complete seating of a restoration. However, the typical tooth-restoration gap that is seen with a good technician is about 50 µ, and often, a far greater space is observed. (Zinc phosphate has a film thickness of 25 µ).

- **Radiopacity** The visibility of the cement in subsequent recall radiographs is very important. This is what allows the dentist to distinguish between cement lines and recurring decay.

- **Consistency** Cements run the gamut from very viscous to very fluid. The choice is a matter of personal preference. Some of the very thick resins require ultrasonic vibration during the seating of the restoration. Some cements are so thin that they will not fill the gap between the tooth and the restoration effectively.

- **Extraoral working time** This is typically not an issue for the newest autopolymerizing cement materials. As well, dentists who work with assistants have fewer working time-related problems. If the dentist is working alone, or trying to seat multiple restorations concurrently, then a longer working time is appropriate. However, in most four-handed practices that use automix cartridges or devices, a shorter extraoral working time is appropriate.

- **Set time** As a cement is setting, it is a good idea to have constant and continuous finger or occlusal pressure on the restoration to prevent its displacement from the cavity. The fluid pressure of the unset cement tends to extrude the inlay, onlay, or crown away from the preparation into high occlusion unless there is a barrier to this movement. At the set time, the pressure is no longer...
The clinical steps required for PFM cementation with three popular cements (Ref. CRA Newsletter, Aug 2004) are described below:

1. **Common preparation steps of removing the provisional crown and cement, and pumicing the tooth are common to all the cements and are not included in the comparison chart. The common crown preparation steps of microabrad- ing or etching the internal surface of the coping are also not listed separately below.**

2. **After seating for each of the cementation techniques described, the margins should be partially light-cured, and the excess cement removed. Then the margins can be fully light-cured, and polished once the cement is set.**

The significant advances in the techniques listed below include the elimination of the tooth preparation steps (etching and priming and bonding) for Embrace and RelyX Unicem. While capsule activation and a triturator are required for RelyX Unicem, Panavia F2.0 is simply pad-mixed and Embrace is even more simply auto-mixed with a dual-barrel syringe through a mixing tip. Panavia F2.0 is spalulated into the crown, while the RelyX Unicem and the Embrace are loaded directly. In each case, the setting of the cement and the clean-up are similarly straightforward.

Today’s resin cements offer a variety of clinical options. They are easy to use clinically and predictable, and continuing development is simplifying the cementation procedure on a regular basis. Resin cements are adhering to dental surfaces (dentin and enamel) and bonding to our commonly used restorative materials (the metals and ceramics). They relate these substrates so effectively that for all intents and purposes they behave as a monobloc, incorporated into a single functional unit.

Material technology advances have eliminated the need to etch or prime the tooth surface, and simplified mixing and dispensing tremendously. As a result, the technique sensitivities that existed with resin cementation have mostly been overcome. With protocol simplification, the confusion that surrounded cementation has been eliminated.

Dr. Freedman is the author or co-author of eight textbooks, more than 200 dental articles, and numerous CDs, videos and audiotapes. An Diplomate of the American Board of Aesthetic Dentistry, he lectures internationally on dental aesthetics, dental technology, and photography. He maintains a private practice limited to Esthetic Dentistry in Toronto, Canada, and can be reached at freedman@epol.com.