Resin-modified glass ionomer: The open sandwich technique

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IN 1972, WILSON AND KENT introduced glass ionomer cements that cure via a simple acid-base reaction. When the two components (glass and acid) were mixed, these materials "self-cured." Twenty years later, "resin-modified glass ionomer cements" were developed that could be light-cured. The term "resin-modified" denotes the addition of resin groups (i.e., HEMA) by virtue of the attachment of these molecular groups to the "acidic liquid component." These light-cured, resin-modified glass ionomer (RMGI) cements offered many benefits. The speed of light-curing vastly shortened the setting time that had been a significant shortcoming of the original self-cure glass ionomers. In addition, the release of fluoride ions was thought to challenge recurrent caries from developing.

THE NEW RMGIs
Most recently, a new group of light-cured RMGIs has been introduced, all with varying recommendations and abilities (e.g., Ionolux, Voco GC Fuji II LC, GC America: PhotoFil Quick Acp. Polysac Fille, Riva Light Cure, SDI). One material, Ionolux, has demonstrated a wider variety of applications than previously recommended for RMGI materials. This modified restorative does dual-cure in that the glass ionomer aspect self-cures with an acid-base reaction and the resin aspect is light-cured, similar to other RMGI brands on the market. It has composite-like esthetics, non-sticky handling, and is immediately packable. This material offers enhanced physical properties, continued fluoride release (found in original glass ionomers), better longevity, does not require dentin conditioning, and is excellent at preventing leakage from intraoral fluids with a low water solubility coefficient, thus preventing fluid absorption (Tables 1 and 2). One of the uses of these RMGI materials has been as a base for Class II and III direct composite restorations, known as the "sandwich technique."

Table 1: Benefits of the new RMGIs
- Composite-like esthetics
- Light-cured for fast finish and flexible working time
- Immediately packable after application
- Does not stick to the instrument, easy to shape
- High translucency for better esthetic results
- High fluoride release (minimizes secondary caries)
- Highly radiopaque
- No dental conditioner or adhesive needed
- Polymerization shrinkage control
- Biocompatible
- Highly polishable
- Natural fluorescence (same as tooth structure)

Table 2: Clinical uses of the new RMGIs
- Sealants
- Temporary restorations
- Dentin substitute
- Small Class I composite restorations
- Base for Class II, III, and IV restorations
- Class V restorations (primarily cervical fillings and root canals)
- Subgingival margins and "margin elevation" for crowns
- Implant access openings
- Restoration of decumbent teeth
- Core buildup

THE SANDWICH TECHNIQUE
When a carious lesion and the Class II cavity preparation extend near to or apical to the cementoenamel junction, the sandwich technique can be used. The technique is described as a layering of various restorative materials within the cavity preparation. It involves placing RMGI at the base of the cavity preparation, followed by curing and the addition of composite restoratives to complete the restoration. If the remaining layers of composite resin completely encase the RMGI, it is considered a "closed" sandwich technique. If the RMGI is exposed to the oral environment at the base of the restoration, it is considered an "open" sandwich technique (Figures 1a and 1b).

Figures 1a and 1b: RMGI sandwich techniques
RESIN-MODIFIED GLASS IONOMER

This technique is not new and was originally proposed by Suzuki and Jordan. According to Liebenberg, "The open-sandwich technique allows the least amount of microleakage of the various direct restorative options currently available." This occurs because traditional composite bonding at the cariesurface and interproximal sites often have a complex combination of substrates that include enamel and varying levels of dentin, depending on the depth of the lesion. Liebenberg continues, "For dentin bonding, it appears far easier to achieve a seal than to maintain it, and in vivo studies have confirmed that resin-dentin bonds degrade in the oral cavity."35

CLINICAL TECHNIQUE
The patient, a 29-year-old man, presented with a failing Class II direct composite restoration in the upper left second premolar (figure 2). A radiograph confirmed the presence of a carious lesion (figure 3). Due to the recurrent caries found in many of the teeth, a conservative treatment plan was made for possible root canal therapy and a direct composite restoration. In cases with recurrent caries, using an RMGI is ideal in that it contains fluoride and provides a more suitable "environment" for restoring deep lesions. The tooth was anesthetized using 4% articaine with 1:200,000 epinephrine x 1.8 cc. The upper left posterior quadrant was isolated using a rubber dam. Following removal of the restoration (figure 4), gross caries was removed using a #6 round stainless steel slow-speed carbide followed by #6 and #4 round slow-speed polymer SmartBurs II (SS White). Complete caries removal was determined by explorer examination and evaluating the existence of cariogenic bacteria using fluorescence (Spectra, Air Techniques). A Triodont sectional matrix system (Ultradent) was placed (figure 5), followed by the application of a base layer using Ionolux RMGI (figure 6). In addition, the Ionolux RMGI was selected for this case due to its high compressive strength, approaching levels seen with the newest generation of flowable composite resins.33 The Ionolux was compressed into the preparation in what was the initial layer of the open sandwich technique. Following the light-curing of the Ionolux (figures 7 and 8), Futurabond U (Voco), a dual-curing, highly flowable, highly translucent, highly polished material was placed using an Air Techniques hand instrument. The material was light-cured (figure 9) and the restoration was completed (figure 10). The restoration was polished and the patient was discharged with a 6-month recall for reevaluation.
cure universal adhesive in a single-dose delivery system, was applied to the preparation and light-cured (figure 9). Admira Fusion (Voco), a universal light-cured, nanohybrid organically modified ceramic (ORMOCER), was placed in the increments. Each increment was light-cured until the restoration was completed (figures 10 and 11). A radiograph was taken to evaluate the immediate success of the restoration (figure 12). The ionomix RMGI demonstrated excellent opacity, comparable to composite resins.

**SUMMARY**

Resin-modified glass ionomers have been used for more than 20 years and have provided numerous benefits to dentistry. With the newest class of RMGIs, additional areas of use have provided new applications for this material, benefitting patients and clinicians alike.

**REFERENCES**