The co-cured, light-activated glass-ionomer cement–composite resin restoration

Geoffrey M. Knight*

The simultaneous curing of unpolymerized composite resin and inactivated light-curing glass-ionomer cement appears to offer a number of clinical improvements to the laminated glass-ionomer cement–composite resin restoration. The observation that composite resin cures before the glass-ionomer cement suggests that the polymerization shrinkage of the resin may be taken up by the uncured glass-ionomer cement, reducing the internal stress of the restoration. A procedure is described for the placement of this type of laminate restoration that reduces both technique sensitivity and placement time, by eliminating a number of the steps required for a conventional "sandwich" restoration. The apparent clinical success of this technique indicates the need for laboratory testing to evaluate the potential of this procedure.
(Quintessence Int, *1994;25:97–100.)*

Introduction

Light-curing glass-ionomer cements have made a rapid and significant impact on the practice of restorative dentistry since their introduction early in 1992. Not only has the light-curing component of these materials improved dentists' productivity, but the reported improvements in clinical properties have also extended their clinical applications.[1,2]

Unlike traditional glass-ionomer cements, the new materials do not require protection from moisture contamination after initiation of the light-curing component of setting. They have improved physical properties over conventional glass-ionomer cements, even if allowed to set without light activation, yet they retain the many clinical benefits of this material. The major disadvantage of the light-curing glass-ionomer cements is the current lack of clinical research to determine their performance over time.[3]

The development of composite resins over the past three decades has produced a clinical material with esthetic properties approaching those of natural teeth and a wear resistance clinically close to that of dental amalgam.[4] Composite resin has the ability to bond micromechanically to dental enamel and to maintain this bond in the oral environment over long periods.[5] Unfortunately, research has not been able to overcome the polymerization shrinkage of resins that continues to require critical consideration during the clinical applications of this material. Furthermore, there is no long-term clinical evidence demonstrating that composite resin has an ability to bond to dentin, and composite resin does not offer fluoride release provided by glass-ionomer cements.[6]

The long-term clinical success observed with glass-ionomer cements[7,8] may be enhanced by the "sandwich restoration," in which dentin is replaced with glass-ionomer cement and enamel with composite resin.[9] The resulting restoration overcomes many of the shortcomings of both glass-ionomer cements and resins; its clinical performance over time contradicts criticism of the procedure.[10] The technique is, however, time consuming and may be subject to failure at the cement-resin interface if the set glass-ionomer cement has not reached sufficient maturity before it is etched.[11]

* Private Practice, 20 Carpenter Street, Brighton, Victoria, 3186, Australia.

This paper investigates a technique of simultaneously curing light-activating glass-ionomer cement and composite resin to enhance the physical properties of the resulting restoration.

The concept of co-curing

The idea of co-curing emerged after the accidental partial curing of specimens of light-activating glass-ionomer cement and composite resin located together on a glass slab. While 2 seconds of curing hardened the resin surface, the glass-ionomer cement remained a viscous paste that was easily indented with a plastic instrument.

It is postulated that during co-curing, as the resin activates before the glass-ionomer cement, the dimensional changes caused by the polymerization shrinkage of the resin may be taken up by the uncured glass-ionomer cement, eliminating many of the internal stresses within the restoration and reducing the likelihood of marginal leakage.[12] Furthermore, this technique eliminates a number of the steps required for the traditional sandwich procedure, thus reducing technique sensitivity and increasing the efficiency of the placement technique.

The technique described below has been used as a routine clinical procedure for more than 16 months. Compared to the sandwich restoration, there is a substantial reduction in the time required for placement and all observations to date indicate a similar, if not superior, clinical performance.

Clinical technique

The restoration of a tooth requires isolation of the cavity from the oral environment. Rubber dam is a useful tool to achieve this but is not essential for a successful outcome.

Figure 1 shows a carious lesion on the occlusal surface of a maxillary permanent first molar. After application of a rubber dam, caries is removed and the remaining occlusal fissures are lightly prepared with a 12-bladed tungsten carbide bur (Fig 2). Preparing the occlusal fissures incorporates the benefits described in the preventive resin restoration.[13]

The preparation is etched for 10 seconds with 37% phosphoric acid (Fig 3), flushed with water, and dried with oil-free air. Phosphoric acid is used on the cavosurfaces to etch the enamel and remove the smear layer from the dentin. Because the etching of enamel is a function of concentration and time,[14] the brief 10-second exposure of the acid to dentin enabled little more than removal of the smear layer. While future investigations may establish superior protocols for preparing tooth surfaces prior to restoration placement, the technique described in this paper has performed satisfactorily at a clinical level and eliminates the need for multiple tooth-conditioning procedures.

A small increment of capsulated Fuji II LC glass-ionomer cement (GC Corp) is next placed at the base of the preparation and cured for 20 seconds. Capsulated glass-ionomer cements assure optimal liquid-powder ratios and facilitate placement of the restorative material. The glass-ionomer cement should fill the cavity up to the dentinoenamel junction (Fig 4). Larger preparations requiring a glass-ionomer base thicker than 3 mm must be cured incrementally. The remaining preparation and occlusal surface are covered with a thin layer of glass-ionomer cement. A plastic instrument is used to place a small plug of resin into the center of the uncured glass-ionomer cement (Fig 5). The resin is puddled toward the periphery of the cavity and over the occlusal fissures with a ball-ended burnisher, so that the glass-ionomer cement is displaced to the margins of the preparation (Fig 6). The glass-ionomer cement and resin are cured simultaneously for 20 seconds.

The restoration is then reduced with a high-speed, pear-shaped stone, used under a water spray to prevent heat dehydration of the yet chemically unset glass-ionomer cement. After removal of the dam, the occlusion is checked with articulating paper (Fig 7) and final polishing is completed with a mounted rubber point (Fig 8). Five months following placement, the restoration has successfully restored the carious lesion and sealed the remaining occlusal surfaces (Fig 9).

Conclusions

The co-curing technique described in this paper has been in routine clinical use over a 16-month period. The fewer clinical steps required for this procedure compared to a conventional sandwich laminate reduce both the technique sensitivity and the time required for placement. Observations of this restoration indicate that it has a clinical performance similar, if not superior, to that of resin and resin laminate restorations.

Further investigations of this technique are required to establish whether the clinical performance observed to date can be substantiated by laboratory testing.

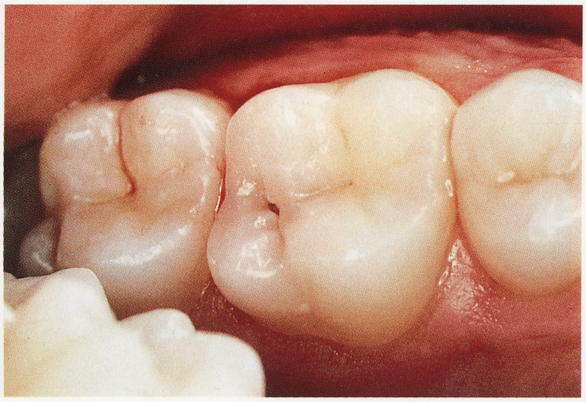

Fig 1 A Class I carious lesion is present on the occlusal surface of a maxillary permanent first molar.

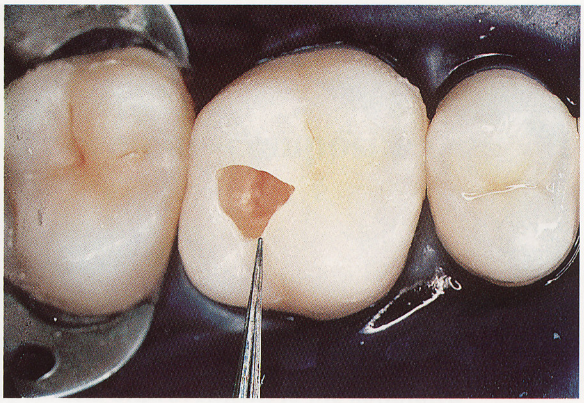

Fig 2 The occlusal fissures are lightly prepared with a 12-bladed tungsten carbide bur to open the fissures slightly to facilitate sealing of the remaining occlusal surface.

Fig 3 The preparation is etched with 37% phosphoric acid for 10 seconds.

Fig 4 A small increment of capsulated, light-activated, glass-ionomer cement is placed at the base of the preparation and cured for 20 seconds. The glass-ionomer cement should fill the preparation up to the dentinoenamel junction.

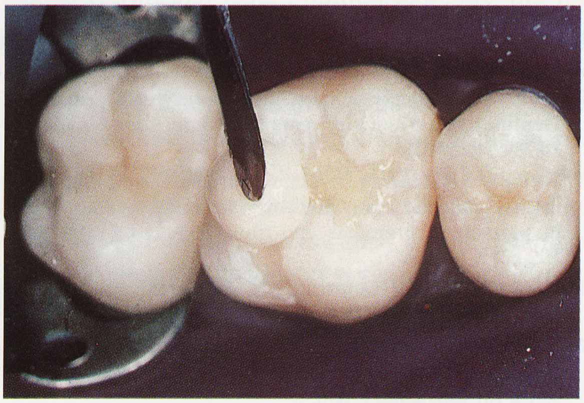

Fig 5 Inactivated glass-ionomer cement is placed over the occlusal surface and a small plug of resin is placed on the surface.

Fig 6 The resin is then puddled toward the margins of the preparation with a ball burnisher.

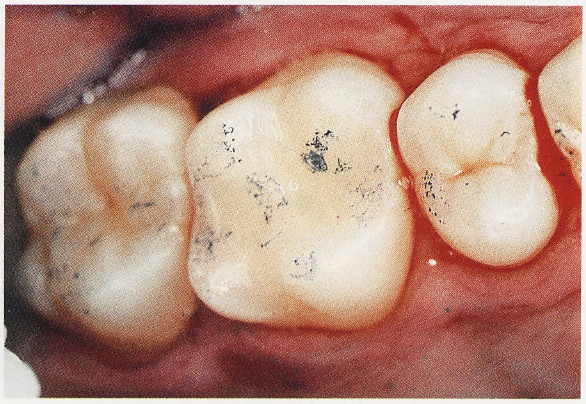

Fig 7 After the restoration has been cured and contoured, the occlusion is checked for prematurities with articulating paper.

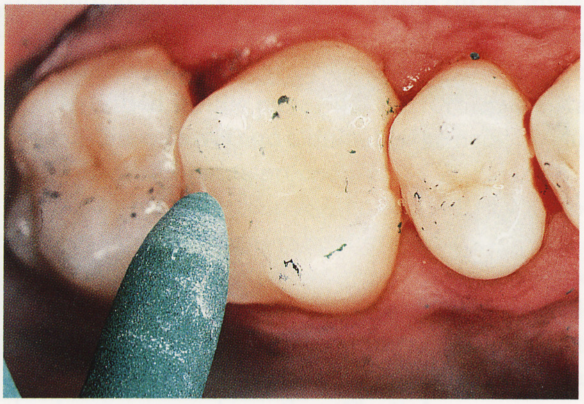

Fig 8 Final polishing of the restoration is completed with a mounted rubber point.

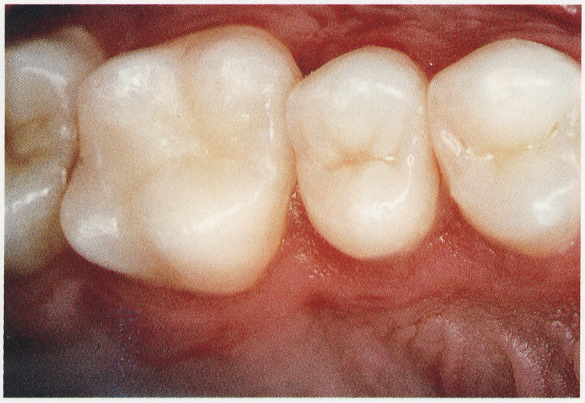

Fig 9 Five months after placement, the restoration is virtually invisible within the occlusal surface.

References

1. Mount GJ. Clinical placement of modern glass ionomer cements. Quintessence Int 1993;24:99–107.
2. Croll TP. Light-hardened Class I glass-ionomer-resin cement restoration of a permanent molar. Quintessence Int 1993;24:109–113.
3. Christensen G. Glass-ionomer-resin restorations. Clin Res Assoc Newsletter 1992;16(3):1–2.
4. Johnson GH, Bales DJ, Gordon GE, Powell LV. Clinical performance of posterior composite resin restorations. Quintessence Int 1992;23:705–711.
5. Tyas MJ, Wassenaar P. Clinical evaluation of four composite resins in posterior teeth. Five year results. Aust Dent J 1991;36:369–373.
6. Forsten L. Fluoride release and uptake by glass ionomers. Scand J Dent Res 1991;99:241–245.
7. Knight GM. The tunnel restoration–Nine years of clinical experience using capsulated glass ionomer cements. Case report. Aust Dent J 1992;37:245–251.
8. Mount GJ. Longevity of glass ionomer cements. J Prosthet Dent 1986;55:682–685.
9. Mount GJ. Clinical requirements for a successful "sandwich"—Dentine to glass ionomer cement to composite resin. Aust Dent J 1989;34:259–265.
10. Welbury RR, Murray JJ. A clinical trial of the glass-ionomer cement–composite resin "sandwich" technique in Class II cavities in permanent premolar and molar teeth. Quintessence Int 1990;21:507–512.
11. Kingsford Smith ED, Martin FE. Acid etching of a glass ionomer cement base: SEM study. Aust Dent J 1990;35:236–240.
12. Sheth PJ, Jensen ME, Sheth JJ. Comparative evaluation of three resin inlay techniques: Microleakage studies. Quintessence Int 1989;20:831–836.
13. Simonsen RJ, Stallard RE. Sealant restorations utilising a diluted composite resin: One-year results. Quintessence Int 1977;8(6):77–84.
14. Kanca J. Resin bonding to wet substrate. II. Bonding to enamel. Quintessence Int 1992;23:625–627. □