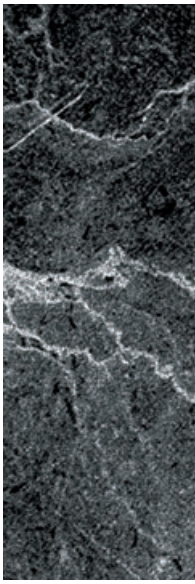

Critical Appraisal

CLASS II COMPOSITE RESIN RESTORATIONS WITH GINGIVAL MARGINS IN DENTIN

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The rising demand for esthetic restorations has considerably increased the number of direct composite restorations being placed in private practices. While composite resin is often selected primarily for its esthetic qualities, another significant advantage of direct composite restorations is the ability to perform conservative cavity preparations. The traditional configuration used for amalgam restorations is no longer mandatory; thus, more sound tooth structure can be preserved.

The technique of composite placement is complex when compared to amalgam placement. The use of adhesive systems prior to placement of composite restorations requires not only excellent isolation to avoid contamination, but also precise manipulation of the adhesive system. While stable bonds to enamel are routinely obtained, the heterogeneous composition and intricate morphology of dentin makes this substrate more challenging to restore. In addition, the cavity configuration (C-factor) and inherent polymerization shrinkage of composite resin play an important role in the durability of the composite–dentin interface. Class II preparations often have gingival margins in root surfaces because of the location of the caries lesion. Clinicians are then faced with a preparation that is challenging to isolate, has a relatively high C-factor, and relies on optimal bonding to dentin to secure long-lasting marginal integrity. Various restorative techniques, such as incremental placement or the use of an intermediate layer (flowable composite or resin-modified glass ionomer cements—open sandwich technique), have been some of the methods proposed to increase the longevity of composite restorations, especially those with margins in dentin. This review evaluates some of the published research on Class II composite resin restorations with margins in the dentin/cementum.

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DOI 10.1111/j.1708-8240.2007.00092.x

THE EFFECTS OF FILLING TECHNIQUES AND A LOW-VISCOSITY COMPOSITE LINER ON BOND STRENGTH TO CLASS II CAVITIES

A.F. Figueiredo, M. Giannini, G.M. Ambrosano, D.C.N. Chan
Journal of Dentistry 2003 (1:59–66)

ABSTRACT

Objective: The purpose of this study was to evaluate different restorative techniques, with or without a low-viscosity liner, on the bond strength of composite to the gingival floor of Class II restorations.

Materials and Methods: Standardized Class II cavity preparations were performed in the mesial and distal surfaces of extracted human molars. The gingival margins were located 1 mm below the cementoenamel junction (CEJ). Control groups were prepared the same way, but cavities were enlarged after preparation (corresponding to a flat dentin surface). The preparations were randomly assigned to four experimental groups: horizontal layering, faciolingual layering, oblique layering, and bulk filling. Each group was tested with or without a low-viscosity intermediate composite layer (Tetric Flow, Ivoclar Vivadent, Schaan, Liechtenstein). All cavity preparations were restored using the Single Bond adhesive system (3M ESPE, St. Paul, MN, USA) and the Spectrum TPH hybrid composite resin (Dentsply deTrey, Konstanz, Germany).

After storage in water for 24 hours, the restored teeth were sectioned to obtain a series of 0.8-mm thick slabs, which were further trimmed into an hourglass shape of approximately 0.8-mm^2 area at the resin–dentin interface. For microtensile bond strength testing, specimens were tested in tension at 0.5 mm/min until failure. Data were analyzed using two-way ANOVA and the Student–Newman–Keuls test at 0.05 level of significance. In addition, interfaces of the fractured specimens were examined using scanning electron microscopy (SEM) to determine failure modes.

Results: Bond strength values ranged from 24.4 MPa in the control, with flowable group to 14.5 MPa in the bulk technique group. The use of a low-viscosity composite resin did not significantly affect the bond strength in any composite placement technique. However, the use of a flowable composite affected the failure mode by increasing the amount of cohesive failures in composite resin, in contrast to adhesive interface failures in groups without flowable. Comparing the various placement techniques, the bulk filling group had the lowest bond strength, but it was not significantly different from the oblique layering technique. All incremental filling groups did not differ from the control, which represented a flat dentin surface.

Conclusions: Dentin bond strengths were not improved when a low-viscosity composite resin was applied, but it substantially affected the failure mode. The use of incremental placement techniques improved the bond strength when compared to the bulk filling technique.

COMMENTARY

This interesting article demonstrates the advantages of the incremental technique on the bond strength of the composite–dentin interface. Several studies have shown the effects of the incremental technique on marginal seal and microleakage, but very few have explored the effect on the bond strength to dentin. The findings of this study reinforce the importance of incremental placement of composite resin.

The study reports that the use of a flowable composite as an intermediate layer between the adhesive system and a hybrid composite did not affect the bond strength to dentin, even when bulk placement was used; however, the fracture mode pattern was different.

Fracture modes are valuable information because we cannot rely only on bond strength values to understand the differences among groups. When flowable composite was used, rupture occurred at the resin portion (cohesive), which might indicate that the adhesive/dentin interface was kept intact. Keeping the dentin sealed could be important to avoid secondary caries formation.

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MODIFIED CLASS II OPEN SANDWICH RESTORATIONS: EVALUATION OF INTERFACIAL ADAPTATION AND INFLUENCE OF DIFFERENT RESTORATIVE TECHNIQUES

I.E. Andersson-Wenckert, J.W. van Dijken, P. Horstedt
European Journal of Oral Sciences 2002 (3:270–5)

ABSTRACT

Objective: The aim of this study was to evaluate interfacial adaptation to enamel and dentin of composite placed in an open sandwich restorative technique using resin-modified glass ionomer cement and composite resin (RMGIC/CR) for Class II preparations in vivo. In addition, different light-curing techniques and matrix bands were evaluated.

By definition, the "open sandwich" technique involves the placement of RMGIC on the gingival margin as a liner that is exposed to the oral environment, while the "closed sandwich" technique involves the placement of RMGIC at the gingival wall but is fully covered by CR and therefore not exposed to the oral environment.

Materials and Methods: Forty box-shaped Class II restorations were placed in vivo in premolars scheduled for extraction after 1 month. The prepared cavities were randomly assigned to one of the five experimental groups:

1. metal band, open sandwich technique using bulk increment of RMGIC (Vitremer, 3M ESPE) and horizontal increments of CR (Z100, 3M ESPE) after the application of the Scotchbond Multi-Purpose adhesive system (3M ESPE)
2. metal band, open sandwich technique using bulk increment of RMGIC and oblique increments of CR
3. plastic band, open sandwich technique using bulk increment of RMGIC and oblique increments of CR
4. metal band, open sandwich technique using bulk increment of RMGIC, liner covering the RMGIC (Tubulitec, Dental Therapeutics, Nacka, Sweden) to prevent acid-etching of the cement, and oblique increments of CR
5. metal band, closed sandwich technique using bulk increment of RMGIC and oblique increments of CR

After 1 month of function, the teeth were extracted, cleaned, and prepared for SEM evaluation. Specimens were sectioned mesiodistally through the midportion of the restoration. Replicas were made of the buccal and lingual sections with a polyvinylsiloxane impression material. Casts generated from the impressions were evaluated by SEM. Quantitative data were obtained by measuring the length of each evaluation score expressed as a percentage of the total length of the examined interface. The scoring system used was as follows:

Score 1 = good adaptation, no marginal opening, no deficiencies
Score 2 = slight marginal irregularities, no gap
Score 3 = severe marginal irregularities, but no gap visible
Score 4 = gap, hairline crack with bottom visible
Score 5 = severe gap, bottom hardly or not visible

Results: Gap-free internal adaptation (score 1–3) to enamel was similar for RMGIC and for CR. Adaptation to dentin was significantly better for RMGIC than for CR. In regard to the internal adaptation, no significant differences were observed between the experimental groups. At the cervical enamel margins, RMGIC (open sandwich technique) showed significantly better marginal adaptation than CR (closed sandwich technique). Overall, interfacial adaptation to dentin and to the cervical enamel was significantly better for RMGIC than for CR.

Conclusion: It can be concluded that the open sandwich technique, using RMGIC as the cervical layer, had a high percentage of gap-free interfacial adaptation in vivo. The different curing and application techniques did not influence the interfacial adaptation. Adaptation to dentin and cervical enamel was significantly better for RMGIC than for CR.

COMMENTARY

This is a valuable clinical study because it evaluates open sandwich restorations placed in vivo and at the same time conducts a laboratory evaluation of the restoration/tooth interface. The study found a smaller percentage of interfacial gap formation when RMGIC was used, which might indicate that RMGIC has better sealing ability than CR. Some clinical trials have reported higher or similar success rates for the open sandwich technique when compared with standard CR restorations. It is important to note, however, that very few studies evaluate the *long-term* effectiveness of the technique, which is crucial information for making decisions on material and technique selection.

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THE EFFECT OF FLOWABLE RESIN COMPOSITE ON MICROLEAKAGE AND INTERNAL VOIDS IN CLASS II COMPOSITE RESTORATIONS

A. Ölmez, N. Öztas, H. Bodur
Operative Dentistry 2004 (6:713–9)

ABSTRACT

Objective: The purpose of this study was to evaluate the influence of two flowable resin composites on marginal microleakage and the presence of internal voids in Class II composite resin restorations with margins below the CEJ.

Materials and Methods: Standardized Class II slot cavity preparations were made on the mesial and distal surfaces of human molars. The preparations were randomly divided into four groups and restored:

Group I. Filtek P60 (3M ESPE) with Filtek Flow (3M ESPE) liner
Group II. Filtek P60
Group III. Tetric Ceram (Vivadent) with Tetric Flow liner
Group IV. Tetric Ceram

Specimens were first thermocycled (5–60°C for 1,500 cycles), then immersed in a dye solution (2% basic fuchsin) for 24 hours. Teeth were removed from the dye, embedded in epoxy resin, and sectioned mesiodistally along their longitudinal axis. The scoring scale used was as follows:

0 = no leakage
1 = leakage extending to half of the cervical wall (light)
2 = leakage extending to the full extension of the cervical wall, but not including the axial wall (moderate)
3 = leakage extending to the full extension of the cervical wall and including the axial wall (severe)

Internal voids were assessed in three separate portions of the restoration (*interface*—gingival margin–resin interface, *cervical*—cervical half of the restoration, and *occlusal* voids—occlusal half of the entire restoration) with a 50× stereomicroscope. Scores for recording voids in the three parts were: score 0 (no voids) and score 1 (some voids exist). The sum of scores for the entire restorations was expressed as *total voids*.

Results: Statistical analysis indicated that the use of flowable composite resins (groups I and III) significantly decreased marginal microleakage and the internal voids or total voids. The pacakable material (Filtek P60) in combination with the flowable liner had fewer voids (interface, occlusal, total) than the more traditional hybrid composite (Tetric Ceram). There was a correlation between the number of internal voids or total voids and the marginal microleakage.

Conclusion: It was concluded that a flowable composite liner in a Class II composite resin with margins below the CEJ might reduce marginal microleakage and voids in the interface and the total number of voids in the restoration.

COMMENTARY

This is one of many studies that have investigated the seal of bonded restorations using microleakage methodology. It presents an interesting topic, correlating the amount of voids at the interface and the degree of microleakage. The authors observed that the use of a flowable composite had a positive effect on the microleakage values. During manipulation of the composite resin, air voids can be incorporated. In addition, microscopic voids can be present at the interface as a result of excess adhesive solvents and/or water not evaporated. As a result of the low viscosity of the flowable composite, it is expected that fewer air voids are formed.

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THE BOTTOM LINE

Despite the recent advances in restorative systems, a composite resin restoration lasts an average of 5 to 10 years in posterior teeth. Clinical studies have reported that approximately 50% of all restorations placed by dentists are replacements of existing restorations. Failure at the interface (secondary caries) is the primary reason given for replacement of composite restorations and accounts for approximately 30 to 60% of all restorations placed. Implementation of various restorative techniques (incremental technique, use of an intermediate layer, and use of the open sandwich technique with resin-modified glass ionomer cement in addition to the composite resin) and the development of new and/or improved composite resin properties have been some of the efforts proposed to increase the longevity of direct adhesive restorations, most notably Class II restorations.

Microleakage has been a laboratory method widely used to evaluate the sealing ability of the tooth-restoration interface, as it might provide pathways for degradation and secondary caries formation. The clinical relevance of laboratory microleakage testing may be questionable, but it allows for comparison among different treatments and techniques. More recently, studies have used microtensile bond strength test to evaluate specific sites within a cavity preparation, and interesting data have been published regarding the effect of materials and restorative technique and their bond strength to dentin (different walls). Some studies have shown no correlation between bond strength and leakage; therefore, caution must be taken in order not to extrapolate the findings.

The use of the incremental filling technique has been extensively investigated using various protocols. Several studies have shown that the use of multiple increments, mainly horizontal and vertical, resulted in higher bond strength and better sealing ability when compared to bulk placement. While not completely clear why multiple increments result in better interface properties, these might reduce the adverse effects of the polymerization shrinkage as well as increase the polymerization rates of the composite resin. It is important to note that the use of the incremental technique is advantageous for both enamel and dentin.

The application of an RMGIC as an intermediate material has been proposed because it has anticariogenic properties, chemically bonds to hard tooth structure, is not as technique-sensitive as adhesive systems, and its hydroscopic expansion may compensate for polymerization shrinkage. On the other hand, it has inferior mechanical properties when compared to composite, a relatively rough surface finish, and high solubility rates. It is important to note that very few studies have evaluated the long-term effectiveness of this technique, and this information is crucial for decision making regarding the restorative technique. The use of the open sandwich technique seems to have its advantages, but as with all techniques and materials, it must be carefully evaluated for correct application.

The use of a low-viscosity composite resin as an intermediate layer has been proposed for Class II restorations to improve marginal adaptation and seal, and to act as a stress-absorbing layer that reduces the effects of polymerization shrinkage. In general, flowable composites have inferior mechanical properties when compared to hybrid composites, and thus are restricted to certain areas of use. The effect of a flowable composite as an intermediate layer is very controversial and seems to be material dependent. Studies have shown a decrease in microleakage when a flowable composite is used beneath several packable composites. Conversely, various studies have reported that flowable composite does not affect the leakage values when placed underneath conventional hybrid composites.

Very few long-term studies have been conducted evaluating the different restorative techniques available, especially randomized controlled trials. The most appropriate technique to restore Class II preparation with margins in dentin/cementum using composite resin requires further research to prove effectiveness over time. Several of the available techniques and materials have their own advantages and disadvantages and can be applied in specific clinical situations as selected by the clinician.

Editor's Note: We welcome readers' suggestions for topics and contributors to Critical Appraisal. Please address your suggestions to the section editor:

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