Shear Bond Strength Evaluation of Resin Composite Bonded to GIC Using Different Adhesives

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Abstract

Background: This study was conducted to evaluate the Shear Bond Strengthof Resin Composite Bonded to GIC Using Different Adhesives.

Material and methods: 40 single-rooted premolar teeth were mounted in iron cylinders that had been filled with acrylic resin up to the cement-enamel junction. By grinding the tooth on a water-cooled model trimmer, a smooth dentin surface was created at 0.5 mm below the dentino-enamel junction. Over the occlusal surface of each sample, a layer of glass ionomer cement with a thickness of 1 mm was applied. Based on the bonding agent type and application period, the tooth specimens were separated into three groups of ten samples each. Over the GIC, the composite material was layered with a 2 mm thickness before being light-cured. To replicate the clinical setting, the GIC surface was not treated to a flawless glass surface.

Results:Significant differences in binding strength values between the various groups were discovered using one-way analysis with ANOVA ($p<0.01$). Group 2 demonstrated stronger bonds than Group 1 and Group 3 ($p<0.01$). The bond strength values in Group 3 were the lowest.

Conclusion:The self-etch primer group used on unset GIC considerably increased the bond strength of the composite to GIC.

Keywords: bond strength, composite, GIC

Introduction

The development of adhesive technique leads to transition from banded to bonded edgewise appliances. The minimum shear bond strength range of 6-8 MPa is often cited in the literature as necessary to avoid bracket deboning during application of orthodontic forces.[1] Silverman and Cohen

first introduced the indirect bracket bonding technique in 1972.[2] They bonded plastic brackets on the plaster model using a methyl methacrylate adhesive, while adhesion between the etched tooth surface and preset adhesive on the bracket was achieved using unfilled Bis-GMA resin. Revolution in the indirect technique was made by Thomas who introduced a method called custom base indirect bonding technique.[3]

Adhesive dentistry has gained steady importance in restorative dentistry during past four decades with the chief goal to achieve an adequately strong bonding of the restorative resin to the tooth structure for optimum retention, minimal microleakage, better colour stability and clinical longevity of the restoration.[4] GIC adhesion mechanism to tooth structure, thermal compatibility with tooth enamel, biocompatibility and low cytotoxicity render to GIC an interesting clinical option for restorative treatments.[5] Thus, the so-called sandwich restoration or "composite-laminated GIC" technique has been used by clinicians. This preserves the fluoride release mechanism and the chemical bond to tooth structure provided by GIC, and improve the esthetic and mechanical properties using a resin composite laminate.[6]

Hence, this study was conducted to evaluate the Shear Bond Strengthof Resin Composite Bonded to GIC Using Different Adhesives.

Material and methods

40 single-rooted premolar teeth were mounted in iron cylinders that had been filled with acrylic resin up to the cement-enamel junction. By grinding the tooth on a water-cooled model trimmer, a smooth dentin surface was created at 0.5 mm below the dentino-enamel junction. Over the occlusal surface of each sample, a layer of glass ionomer cement with a thickness of 1 mm was applied. Based on the bonding agent type and application period, the tooth specimens were separated into three groups of ten samples each. Over the GIC, the composite material was layered with a 2 mm thickness before being light-cured. To replicate the clinical setting, the GIC surface was not treated to a flawless glass surface.

Group 1: Total-etch bonding agent

Group 2: Self-etch primer before initial set of GIC

Group 3: Self-etch primer after initial set of GIC

After the initial GIC set had been verified with a sharp explorer after seven minutes, self-etch adhesive was used. After 20 seconds of air drying, a self-etching bonding agent was applied, and the light was then cured. The composite material was then put in 2 mm increments, curing light for 40 seconds between each increment. The samples were then kept at room temperature with 100% humidity for 48 hours.The one-way analysis of variance (ANOVA) method was used to compute and analyse the data. The SPSS program version 13 was used to conduct the analysis.

Results

Table 1: The mean shear bond strength.

Group	Mean Shear Bond Strength
Group 1-Total etch	4.61
Group 2-Self etch before setting of GIC	5.36
Group 3-Self etch after setting of GIC	4.01

Significant differences in binding strength values between the various groups were discovered using one-way analysis with ANOVA ($p<0.01$). Group 2 demonstrated stronger bonds than Group 1 and Group 3 ($p<0.01$). The bond strength values in Group 3 were the lowest.

Discussion

A strong bond between GIC and composite is an important factor for the quality of bilayered or sandwich restorations and it has been previously shown that GIC and composite resin can adhere effectively to each other.[7,8] The bond strength between these materials is influenced by four factors: 1) the tensile strength of GIC, which is mostly dependent on the powder/liquid ratio; 2) the viscosity of the bonding agent and its ability to wet the GIC's surface; 3) the volumetric change in the composite resin during polymerization and; 4) the difficulties in packing and adaptation of the composite resin to the GIC without incorporation of voids.[9]

Bond strength of composite resin to glass-ionomer cement can be better when a self-etching primer is employed over unset GIC when compared to the use of total-etch adhesive.[10]The unset form of glass ionomer cement provides a more conducive medium for effective chemical reaction.

Hence, this study was conducted to evaluate the Shear Bond Strengthof Resin Composite Bonded to GIC Using Different Adhesives.

In this study, significant differences in bonding strength values between the various groups were discovered using one-way analysis with ANOVA ($p<0.01$). Group 2 demonstrated stronger bonds than Group 1 and Group 3 ($p<0.01$). The bond strength values in Group 3 were the lowest.

Gopikrishna et al[10]evaluated the bonding ability of composite to glass ionomer cement (GIC) using three different bonding systems. One hundred samples of composites bonded to GIC were prepared and divided into five groups. In Group A, the composite was bonded to GIC after the initial setting of the GIC being employed as a total-etch adhesive. In Group B, the self-etch primer was employed to bond composite to GIC before the initial setting of the GIC. In Group C, the self-etch primer was employed to bond composite to the GIC after the initial setting of the GIC. In Group D, the GIC-based adhesive was employed to bond composite to the GIC before the initial setting of the GIC. In Group E, the GIC-based adhesive was employed to bond composite to the GIC after the initial setting of the GIC. Shear bond strength analysis was performed at a crosshead speed of 0.5 mm/minute. The results were tabulated and the statistical analysis was performed with one-way ANOVA; the Tukey's test showed that the bond strength of composite to GIC was significantly higher for the self-etch primer group employed on unset GIC and the GIC-based adhesive group employed on the set GIC for bonding composite to GIC.

Scougall et al[11]compared the shear bond strength (SBS) of orthodontic brackets bonded with 4 self-etching adhesives.A total of 175 extracted premolars were randomly divided into 5 groups (n = 35). Group I was the control, in which the enamel was etched with 37% phosphoric acid, and stainless steel brackets were bonded with Transbond XT (3M Unitek, Monrovia, Calif). In the remaining 4 groups, the enamel was conditioned with the following self-etching primers and adhesives: group II, Transbond Plus and Transbond XT (3M Unitek); group III, Clearfil Mega Bond FA and Kurasper F (Kuraray Medical, Tokyo, Japan); group IV, Primers A and B, and BeautyOrtho Bond (Shofu, Kyoto, Japan); and group V, AdheSE and Heliosit Orthodontic (IvoclarVivadent AG, Liechtenstein). The teeth were stored in distilled water at 37 degrees C for 24 hours and debonded with a universal testing machine. The adhesive remnant index (ARI) including enamel fracture score was also evaluated. Additionally, the conditioned enamel surfaces were observed under a scanning electron microscope.The SBS values of groups I (19.0 +/- 6.7 MPa) and II (16.6 +/- 7.3 MPa) were significantly

higher than those of groups III (11.0 +/- 3.9 MPa), IV (10.1 +/- 3.7 MPa), and V (11.8 +/- 3.5 MPa). Fluoride-releasing adhesives (Kurasper F and BeautyOrtho Bond) showed clinically acceptable SBS values. Significant differences were found in the ARI and enamel fracture scores between groups I and II.The 4 self-etching adhesives yielded SBS values higher than the bond strength (5.9 to 7.8 MPa) suggested for routine clinical treatment, indicating that orthodontic brackets can be successfully bonded with any of these self-etching adhesives.

Conclusion

The self-etch primer group used on unset GIC considerably increased the bond strength of the composite to GIC.

References

1. Reynolds IR. A review of direct orthodontic bonding. Br J Orthod. 1975;2:171–178.
2. Silverman E, Cohen M. A universal direct bonding system for both metal and plastic brackets. Am J Orthod Dentofacial Orthop. 1972;62:236–244.
3. Thomas RG. Indirect bonding: simplicity in action. J Clin Orthod. 1979;13:93–106.
4. Mandava D, Ajitha P, Lakshmi-Narayanan L. Comparative evaluation of tensile bond strengths of total-etch adhesives and self-etch adhesives with single and multiple consecutive applications: An in vitro study. J Cons Dent. 2009;12(2):55–59.
5. Xie D, Brantley WA, Culbertson BM, Wang G. Mechanical properties and microstructures of glass-ionomer cements. Dent Mater. 2000;16:129–38.
6. Dellabona A, Pinzetta C, Rosa V. Effect of acid etching of glass ionomer cement surface on the microleakage of sandwich restorations. J Appl Oral Sci. 2007;15(3):230–34.
7. McLean JW, Powis DR, Prosser HJ. The use of glass ionomer cements in bonding composite resin to dentine. Brit Dent J. 1985;158:410–14.
8. Mount GJ. Clinical requirements for a successful ‘sandwich’ - dentine to glass ionomer cement to composite resin. Aust Dent J. 1989;34:259–65.
9. Mount GJ. The tensile strength of the union between various glass ionomer cements and various composite resins. Aust Dent J. 1989;34:136–46.
10. Gopikrishna V, Abarajithan M, Krithikadatta J, Kandaswamy D. Shear bond strength evaluation of resin composite bonded to GIC using three different adhesives. Oper Dent. 2009;34:467–71.
11. ScougallVilchis RJ, Yamamoto S, Kitai N, Yamamoto K. Shear bond strength of orthodontic brackets bonded with different self-etching adhesives. Am J Orthod Dentofacial Orthop. 2009 Sep;136(3):425-30.