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Original ARTICLE

Assessment of micro-shear bond strength of resin modified glass-ionomer to composite resins using various bonding systems

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ABSTRACT
Background: Glass-ionomer cement (GIC) was introduced in the 1970s by Wilson and Kent. Initial conventional GICs had some disadvantages, so polymerizable functional groups were added to their structure in order to improve the clinical application and physical and chemical properties of conventional GICs, which yielded resin-modified glass-ionomer cements (RMGICs). **Aim of the study:** To assess micro-shear bond strength of resin modified glass-ionomer to composite resins using various bonding systems. **Materials and methods:** The present study was conducted in the Department of Conservative Dentistry of the dental institutions. In the present study, we compared GIC and composite resin. A total of 40 specimens of each of the material were fabricated for evaluation. The GIC was manipulated, inserted into acrylic artificial cavities (0.2 cm depth × 1 height × 1 cm width), and pressed with a Mylar strip and a glass slide to protect the material and ensure a smooth surface. Half of the specimens in each group were submitted to a micro-shear test in a universal testing machine with a 50 kgf load cell at a crosshead speed of 0.5 mm/min. The other half was subjected to aging in a thermal cycler and then the micro-shear test. All samples were analyzed in the stereomicroscope at ×10 magnification to evaluate the interfacial fracture and classified as adhesive, cohesive, or mixed. **Results:** We observed that the micro shear bond strength of composite was more as compared to GIC in both the stages. The shear bond strength of both the materials decreased significantly after thermal cycling. **Conclusion**: Within the limitations of the present study, it can be concluded that the micro-shear bond strength of composite resin to GIC was higher.
Keywords: Shear bond strength, composite, GIC

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INTRODUCTION

Glass-ionomer cement (GIC) was introduced in the 1970s by Wilson and Kent. Initial conventional GICs had some disadvantages, [1, 2] so polymerizable functional groups were added to their structure in order to improve the clinical application and physical and chemical properties of conventional GICs, which yielded resin-modified glass-ionomer cements (RMGICs).[3] One of the most popular tooth colored restoratives is composites. An unavoidable characteristic of dental composite is shrinkage. Clinical effects of the shrinkage stress may include postoperative sensitivity, cuspal strain or microcracks in enamel or dentin, marginal gap formation, and microleakage. [4]

Microleakage has been identified as a significant problem because of interfacial gap formation, which can result in tooth discoloration, recurrent caries possible pulpal involvement, and restoration replacement. [5] Internal adaptation means adaptation to the internal dimensions of the cavity form. [6] A correlation exists between internal adaptation and the presence of total voids. Hence, the present study was conducted to assess micro-shear bond strength of resin modified glass-ionomer to composite resins using various bonding systems.

MATERIALS AND METHODS

The present study was conducted in the Department of Conservative Dentistry of the dental institutions. The ethical clearance for the study was approved from the ethical committee of the hospital. In the present study, we compared GIC and composite resin. A total of 40 specimens of each of the material were fabricated for evaluation. The GIC was manipulated, inserted into acrylic artificial cavities (0.2 cm depth × 1 height × 1 cm width), and pressed with a Mylar strip and a glass slide to protect the material and ensure a smooth surface. The setting time of the material (6 min) was respected before the surface treatment. The resin specimens for micro-shear testing were prepared using starch tubes. These tubes delimited the adhesive interface's area and worked as conformers for insertion of the high-flow resin composite. They were stabilized in position with a gingival barrier. The flowable composite was inserted within each starch tube and light-cured for 40 s. The starch tubes softened by the moisture and could be easily removed with a manual instrument. Half of the specimens in each group were submitted to a micro-shear test in a universal testing machine with a 50 kgf load cell at a crosshead speed of 0.5 mm/min. The other half was subjected to aging in a thermal cycler and then the micro-shear test. All samples were analyzed in the stereomicroscope at ×10 magnification to evaluate the interfacial fracture and classified as adhesive, cohesive, or mixed.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

RESULTS

Table 1 shows mean micro-shear bond strength (Mpa) of composite and GIC immediately and after cycling in thermal stage. We observed that the micro shear bond strength of composite was more as compared to GIC in both the stages. The shear bond strength of both the materials decreased significantly after thermal cycling. [Fig 1] The results on comparing were found to be statistically significant ($p<0.05$).

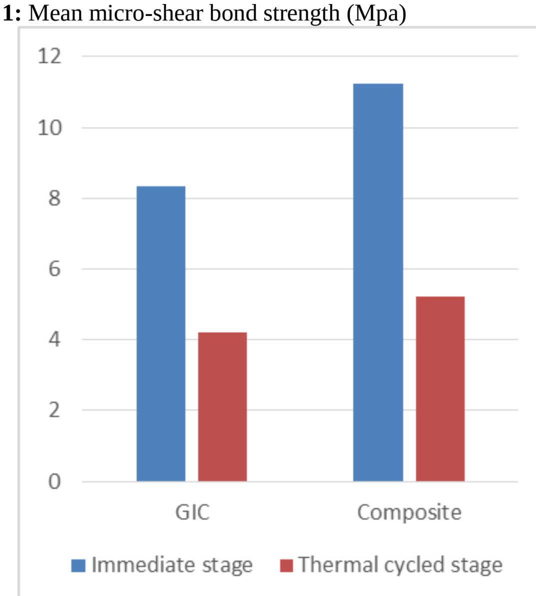
Table 1: Mean micro-shear bond strength (Mpa) of composite and GIC

Restorative material	Mean micro-shear bond strength (Mpa)	
	Immediate stage	Thermal cycled stage
GIC	8.32	4.21
Composite	11.25	5.22

DISCUSSION

In the present study, we observed that shear bond strength of composite was more as compared to GIC. The results were statistically significant. Kasraie S et al compared the micro-shear bond strength between composite and resin-modified glass-ionomer (RMGI) by different adhesive systems. A total of 16 discs of RMGI with a diameter of 15 mm and a thickness of 2 mm were randomly divided into four groups. Four cylinders of composite resin (z250) were bonded to the RMGI discs with Single Bond, Clearfil SE Bond and Clearfil S3 Bond in Groups 1-3, respectively. The fourth group was the control. Samples were tested by a mechanical testing machine with a strain rate of 0.5 mm/min. Failure mode was assessed under a stereo-microscope. The means of micro-shear bond strength values for Groups 1-4 were 14.45, 23.49, 16.23 and 5.46 MPa, respectively. Using a bonding agent significantly increased micro-shear bond strength. They concluded that micro-shear bond strength of RMGI to composite increased significantly with the use of adhesive resin. The bond strength of RMGI to composite resin could vary depending upon the type of adhesive system used.

Fig 1: Mean micro-shear bond strength (Mpa)



Boruziniat A et al evaluated bond strength between RMGI and composite using different adhesive systems and curing techniques. Sixty prepared samples of RMGI were randomly divided into six groups according to adhesive systems (total-etch, two-step self-etch and all-in-one) and curing techniques (co-curing and pre-curing). In co-curing technique, the adhesive systems were applied on uncured RMGI samples and co-cured together. In the pre-curing technique, before application of adhesive systems, the RMGI samples were cured. Composite layers were applied and shear bond strength was measured. Two samples of each group were evaluated by SEM. Failure mode was determined by streomicroscope. Both curing methods and adhesive systems had significant effect on bond strength. There was an interaction between two factors (P-value <0.05). Both self-etch adhesives had significantly higher shear bond strength than the total-etch adhesive (P-value <0.05). The co-curing technique improved the bond strength in self-etch adhesives, but decreased the bond strength in total-etch adhesive. They concluded that the application of self-etch adhesive systems and co-curing technique can improve the bond strength between the RMGI and composite. [7, 8]

Pandey SA et al evaluated and compared shear bond strength of composite resin to resin modified glass ionomer cement using HEMA-based and HEMA-free adhesive systems. Total 30 disc-shaped samples were prepared with resin modified glass ionomer cement (RMGIC). Samples were divided into three groups, each group containing 10 samples. Group I (n=10): Nano-hybrid composite resin (NHCR) was bonded to RMGIC without any adhesive system. Group II (n=10): NHCR was bonded to RMGIC using hydroxyethylmethacrylate (HEMA)-based adhesive system. Group III (n=10): NHCR was bonded to RMGIC using HEMA-free adhesive system. The shear bond strength was tested using Universal testing Machine and the results were calculated using one way ANOVA and Post-Hoc test. Maximum shear bond strength was recorded in group III where HEMA-free adhesive used with a mean value of 6.13±1.859 MPa followed by group II where HEMA-based adhesive used with mean value of 4.38±1.533 MPa. The control group showed least shear bond strength. It was concluded that application of HEMA-free adhesive (OptiBond All-In-One) resulted in greater shear bond strength between RMGIC and composite resin than HEMA-based adhesive (Single bond Universal Adhesive). Sharafeddin F et al assessed the effect of adding micro- and nano-hydroxyapatite (HA) powder to RMGI on the shear bond strength (SBS) of nanofilled and silorane-based composite resins bonded to RMGI containing micro- and nano-HA. Sixty cylindrical acrylic blocks containing a hole of 5.5×2.5 mm (diameter × height) were prepared and randomly divided into 6 groups as Group 1 with RMGI (Fuji II LC) plus Adper Single Bond/Z350 composite resin (5.5×3.5 mm diameter × height); Group 2 with RMGI containing 25 wt% of micro-HA plus Adper Single Bond/Z350 composite resin; Group3 with RMGI containing 25 wt% of nano-HA plus Adper Single Bond/Z350 composite resin; Group 4 with RMGI plus P90 System Adhesive/P90 Filtek composite resin (5.5×3.5 mm diameter × height); Group 5 with RMGI containing 25 wt% of micro-HA plus P90 System Adhesive/P90Filtek composite resin; and Group 6 with RMGI containing 25 wt% of nano-HA plus P90 System Adhesive/P90 Filtek composite resin. The specimens were stored in water and subjected to 1000 thermal cycles. SBS test was performed by using a universal testing machine at a crosshead speed of 1 mm/min. Data were analyzed by two-way ANOVA and Tukey test. There were significant differences between groups 1 and 4, and groups 3 and 6. However, among Z350 and P90 specimens, no statistically significant difference was detected in the SBS values. They concluded that RMGI containing HA can improve the bond strength to methacrylate-based in comparison to silorane-based composite resins. Meanwhile, RMGI without HA has the best bond strength to silorane-based composite resins. [9, 10]

CONCLUSION

Within the limitations of the present study, it can be concluded that the micro-shear bond strength of composite resin to GIC was higher.

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