SURFACE TREATMENT EFFICACY ON SHEAR BOND STRENGTH OF RESIN COMPOSITE BONDED TO DIFFERENT TYPES OF GIC

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Abstract

Objective: *To evaluate and compare the shear bond strength of dental composite bonded to dif-ferent chemical and light cure GICs.*

Materials & Methods: *This an in vitro experimental study was assessed to compare the bondstrength of composite resin bonded to chemical cure GICs (Fuji IX, Chemfil rock & Fuji Plus) andlight cure GIC (Fuji II LC) via simplified etching techique and with or without the use of bondingagent after one day. Polyvinyl siloxane moulds were used for making discs (n=30) having a diam-eter of 10 mm and a height of 2 mm for each chemical and light cure GIC. All discs of chemicalcure GIC were auto-cured for the period of 15 minutes while Fuji II LC discs were cured by lightfor 20 seconds. These discs were then embedded in chemically cured acrylic to form blocks.The composite cylinders (n=120) with the dimensions of 7mm diameter and 5mm height werefabricated. After preparing cylinders, the dics were either non-etched or etched with or withoutthe application of a bonding agent. These prepared samples were covered with wet paper andsealed in bags having 100 % humidity and stored at 37 °C in an incubator. Finally, shear bondstrength was investigated after one day by Instron testing machine. The speed adjusted was 0.5mm/min and fracture load was 1 KN. T-test analysis was done to find out statistical differences.*

Results: *Higher shear bond strength values for RMGICs with acid etching and bonding agentwere observed as compared to GICs whereas GICs showed higher shear bond strength valueswith acid etchant alone. While RMGIC (Fuji II LC) showed low value with acid etchant aloneand highest with the addition of bonding agent. But Fuji Plus showed a high value than bothGICs with acid etchant alone.*

Conclusion: *RMGICs bonded to composite with the use of both acid etchant and bonding adhesivehad greater values of shear strength than GICs. While GICs had higher bond strength values withacid etching only than Fuji II LC.*

Keywords: *Acid etching, composite resin, dental adhesive, glass ionomer cement, sandwichtechnique*

INTRODUCTION

The variety of tooth coloured restorative materials, resin composite and glass ionomer cement (GIC) are available in the market which was introduced at the end of 1960.[1] Dental composite is popular in the field of restorative dentistry due to superior aesthetics and oral stability. Despite these demanding characteristics, it has several drawbacks such as high thermal expansion coefficient, polymerization shrinkage, pulpal irritation and adhesion failure leading to micro-leakage and secondary caries.[2,3] To minimize polymerization shrinkage and microleakage, GIC is used under composite resin restoration called laminate or sandwich restoration.[4]

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The laminate technique was first presented by McLean to overcome the problem of microleakage.[5] Chemical and dual cure GICs can be used for this purpose.[6] So the advantage of chemical bonding and fluoride release is taken from resin composite and conventional or modified GIC i.e. resin modified glass ionomer cement (RMGIC). The longevity of this technique depends on the bond strength of GIC or RMGIC to resin composite as there is a difference in setting and adhesion mechanisms.[7] The longer setting time, moisture sensitivity and poor cohesive strength of GIC, as well as minimum chemical adhesion between both resin and GIC, resulted in the development of RMGIC. This modified GIC has been introduced to improve manipulative and mechanical properties, but their use is still limited in clinical practice due to low resistance to abrasion and low aesthetic appearance.[8]

The differences in setting reactions and adhesion of GIC or RMGIC and composite resin is when considered, the bonding between materials and bonding to the tooth becomes an important factor.[1] Though, till now, limited knowledge regarding surface treatments and the effect of resin based adhesive on the surface of self or light cured RMGIC prior to resin composition application is available in the literature. Therefore, the current research was carried out in order to determine and compare the effect of acid etching and application of resin adhesive on shear bond strength of resin composite bonded to chemical and light cure GICs.

MATERIALS AND METHODS

In this laboratory based experimental study, thirty discs of each chemical (Fuji IX, Chemfil Rock and Fuji Plus) and light cure GIC (Fuji II LC) were fabricated from metal moulds having dimensions of 10 mm diameter x 2 mm height.[9] So total one hundred and twenty cylinders of resin composite (XRV Herculite Enamel, Kerr Italla S.r.l) were prepared from metal moulds having dimensions of 7 mm diameter x 5 mm height (Figure 1). Initially, polyvinyl siloxane (PVS) sheets were adapted in the metal moulds (Figure 2).[10] The composite cylinders were fabricated from 5 mm thick PVS sheet whereas it was 2 mm for discs of both chemical and light cure GIC. The capsules of chemically cured GICs were activated one by one and positioned in a roto mix according to the instructions of the company. The extruder was used to put mixed material in the split mould and excess was removed by finger pressure on acetate strip and metal plate. Then the mould was clamped and placed in an incubator for 15 minutes in order to accomplish setting. The discs of light cured GIC were prepared by curing the mixed material with a light emitting diode (LED) for 20 seconds and the intensity used was according to the Manufacturers' instruction i.e. 1200 mW/cm².

These discs were then embedded in self-cure acrylic resin to make acrylic blocks[11] and were covered with damped paper, sealed in plastic bags having 100 % humidity and kept at 37 °C in an incubator till testing was not performed. The discs of each chemical and light cure GIC were then divided into three groups and their surfaces were either manipulated with no acid etching & application of adhesive (Optibond Solo Plus, Kerr Italla S.r.l), etching with 37.5 % phosphoric acid or etching followed by resin adhesive application. The cylindrical PVS moulds were placed in the middle of the prepared and treated discs in the above ways. The etching was done for 15-30 seconds and after application of adhesive agent, discs were cured for 10 seconds followed by incremental layering and light curing of resin composite. Then PVS mould was removed by cutting it and samples were re-cured. Finally, these samples were wrapped in moist paper, packed in plastic bags and kept in an incubator having temperature of 37 °C & 100 % humidity.[12] Shear bond testing of the samples was performed via the Instron testing machine (M30K) by applying a shear load of 1 KN at 0.5 mm/min speed[13] (Figure 3 and 4). The shear load that de-bonded the materials was noted in newton and converted into MegaPascal (MPa).

The data was managed in Microsoft excel 2013 to get means and standard deviations which were calculated for no acid etching and acid etching & adhesive (bonding) agent groups as bonding in control group was not observed. T- Test analysis was done to compare samples treated with acid etchant alone, acid etching & adhesive and between acid etching acid etching plus adhesive resin.

RESULTS

The means and standard deviations for each group (etching/etching plus bonding) of chemical or light cured GICs are given below in table 1.

The highest shear strength at one day (Figure 5) was seen for Chemfil Rock (4.000 ± 1.330 MPa), followed by Fuji plus (3.870 ± 1.320 MPa), Fuji IX (3.020 ± 0.650 MPa) and Fuji II LC (2.120 ± 0.590 MPa) in only etching group. While in etching plus bonding group, the higher bond strength was observed for Fuji Plus (6.650 ± 3.170 MPa) and lower strength was observed for Fuji IX (4.890 ± 0.820 Mpa).

One – way ANOVA analysis was carried out for variance in homogeneity by MatProc statistic descriptive effects homogeneity brownforsythe welch/Posthoc=Tukey Alpha. The comparison was found statistically significant between groups and within groups. A significant statistical difference was observed between materials with the application of acid etchant/Acid etchant + bonding agent between Fuji IX & Chemfil rock (P = 0.002), Fuji II LC (P = 0.000), Fuji Plus (P = 0.002). Similarly, Fuji Plus showed a significant difference by using acid etchant & acid etchant + bonding agent (P = 0.000). Acid etchant and bonding application with Chemfil rock and Fuji II LC also showed significant difference with just acid etchant Fuji plus (P = 0.000). But there was no statistical difference (P > 0.05) between the bonding agents of all GICs (Fig 6).

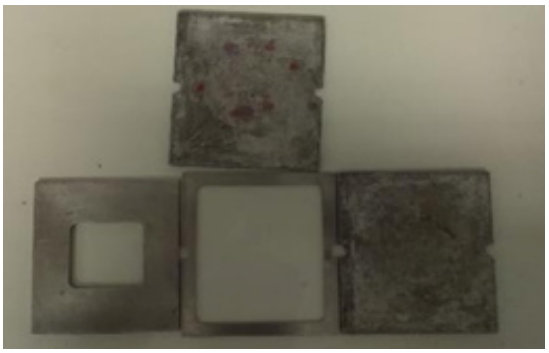

Fig 1: Metal moulds

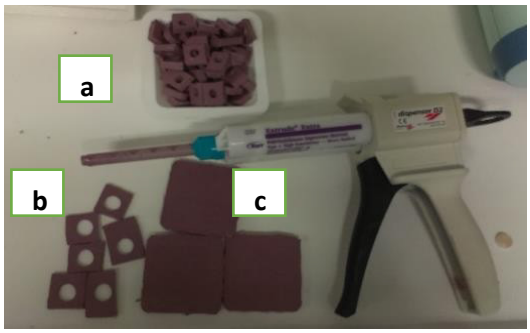

Fig 2: a) Cylindrical mould, b) Disc mould & c) PVS sheet

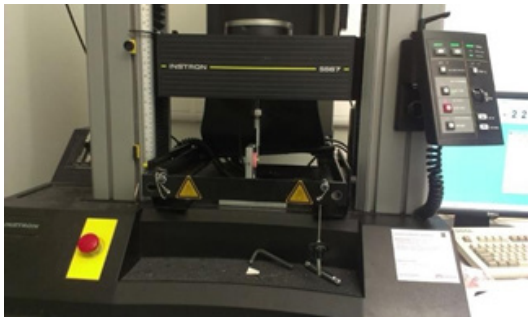

Fig 3: Instron Testing Machine

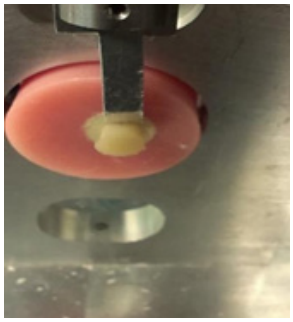

Fig 4: Chisel at Resin Composite

DISCUSSION

The base of GIC is suggested beneath resin composite lamination in sandwich restoration to reduce microleakage. The bonding between the two materials is a significant factor when adhesion, retention and longevity of the restoration are considered.[14] The consensus about pre- treatment of tooth enamel and dentine before the placement of restorative resin is present in literature but the surface treatment of chemical and light cured GIC is still controversial. Previously there was no agreement with the acid etching of the GIC surface in laminate restorations.

McLean and colleagues advocated acid etching of GIC prior to the incremental layering of resin composite to achieve mechanical retention of ad-

Table 1: Shear Bond Strength of all GICS at one day

Chemical / Light Cured GIC	Surface treatment	Mean (MPa)	Standard Deviation
Fuji IX (Conventional, Chemical cured GIC) GC Corporation, Tokyo Japan	Only etching	3.020	0.650
	Etching + Bonding	4.890	0.820
Chemfil Rock (Conventional, Chemical cured GIC) Dentsply DeTrey GmbH, Germany	Only Etching	4.000	1.130
	Etching + Bonding	6.000	1.550
Fuji Plus (Chemical cured RMGIC) GC Corporation, Tokyo Japan	Only Etching	3.870	1.320
	Etching+ Bonding	6.650	3.170
Fuji II LC (Light cured RMGIC) GC Corporation, Tokyo Japan	Only Etching	2.120	0.590
	Etching + Bonding	6.060	1.990

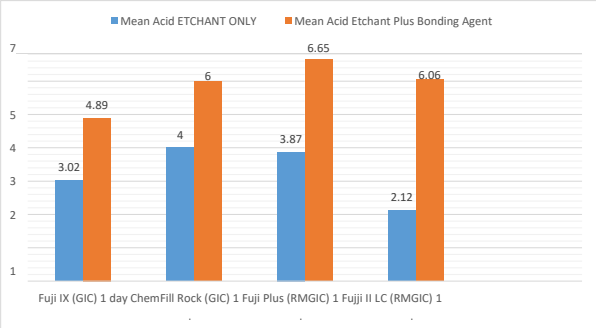

Fig 5: Shear Bond Strength of Chemical and Light Cure GICs

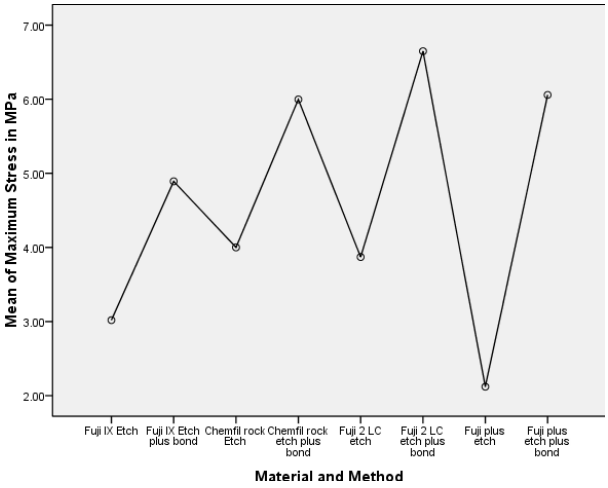

Fig 6: Bar chat to show the statistical analysis

hesive in the acid etched surface of GIC. However, this method is rejected by other investigators because acid etching results in cohesive failure of the cement. Contrary to this, Pamir et al1 observed that the etching had a significant effect on the bond strength of resin composite bonded to both GIC and RMGIC and no subsurface

deterioration was seen in GICs. The current study also revealed that surface treatment of conventional GICs with only acid etchant enhanced the shear bond strength as compared to the use of bonding agent used as well. The self and light cured RMGICs showed lowered values when treated with only acid etching. This finding was consistent with the study done by Navimipour et al[15] mentioning that RMGIC contains a large amount of HEMA and the portion of it which makes the bond with composite may get eliminated.

The chemically cured conventional GICs treated with both acid etching and resin adhesive application in the present study presented a slight enhancement in the bond strength and is similar to the findings of Becci et al[12] that confirmed the bonding between the GIC and dental composite improved with the use of the adhesive system. Unlike in the present study, Becci, et al used different GICs, composite resin materials, bonding agent, GICs/composite dimensions and testing methodology but the test was performed by storing for one day at 37 °C & 100% humidity. In the present study, self and light cured RMGICs influenced the bond strength significantly when both etching and bonding application was done and is similar to results obtained by Panahandeh et al[16] in their research.

The mean shear bond strength for Fuji II LC with the use of both acid etchant and the adhesive agent was very low i.e. 6.06 MPa at one day compared to the study of Otsuka et al[7] that observed the higher bond strength (10.3 MPa). The difference in the values can be because of different bonding agent used, low concentration of phosphoric acid etchant, the

high testing speed, the low intensity of light curing unit and the different resin composite as compared to the present study.

CONCLUSION

The conventional chemically cured GICs presented high shear strength for acid etching only. Modified GICs either chemical or light cured also showed higher shear strength values but with the use of resin adhesive. Thus, shear strength improved for chemical and light cured GICs with the use of etching followed by application of resin adhesive.

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