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Research Article

SHEAR BOND STRENGTH BETWEEN TWO GLASS IONOMER CEMENTS AND THREE DIFFERENT COMPOSITE RESINS: A COMPARATIVE STUDY

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ABSTRACT
In a time where adhesive dentistry is becoming popular day by day, composite restorations are becoming more popular for restorations of posterior teeth. The sandwich restoration comprising of a glass ionomer (GIC) base on which a composite restoration is placed, gives us a unique restoration which utilizes properties like fluoride release, adhesion to tooth and physical properties similar to that of dentine of GIC and micromechanical bonding and esthetics of composite in a single restoration, with an added advantage of reduced C-factor. Development of resin modified glass ionomer (RMGIC), has added a new advantage wherein the composite not only bond to GIC by mechanical interlocking but the resin cross linking will occur between them. This study is aimed to determine the best combination of three commercially available composites and two types of GIC i.e RMGIC and type II restorative GIC.

Key Words: *Sandwich Technique, Resin Modified Glass Ionomer, Shear Bond Strength, Glass Ionomer Cement*

INTRODUCTION
The glass ionomer cements developed by Wilson and Kent (1971) have several advantages such as fluoride release (Forsten, 1977; De Schepper *et al.,* 1990 and Swift *et al.,* 1990) adhesion to mineralized dental tissues, (Wilson and McLean, 1988), and a coefficient of thermal expansion similar to that of tooth structure (Wilson and McLean, 1988). Because of these favorable properties, McLean and Wilson (1977) proposed the placement of glass ionomer cements on dentin prior to the application of a resin composite. This restorative method is commonly referred to as the sandwich technique. This procedure makes optimal use of the adhesive properties and biocompatibility of the glass ionomer cement and the desirable surface and esthetic appearance of composite resin. In a time where esthetic dentistry is gaining popularity, posterior composite restoration has become a norm in restoring posterior teeth whether it's a conservative restoration or a post endodontic restoration. Giving a glass ionomer base below a composite restoration in vital teeth will prevent the occasional post operative sensitivity problem and in endodontically treated tooth a glass ionomer base will provide a better coronal seal thereby improving the prognosis of endodontic treatment. This study is being done to ascertain the best possible combination of type of glass ionomer cement and composite resin to do this.

MATERIALS AND METHODS
Following are the materials chosen for the purpose of this study

a. RMGIC (Viterbond 3M ESPE)
b. Type II GIC (fuji type II)
c. Filtec p60 (3M ESPE)
d. Tetric n- ceram (IVOCLAR VIVADENT)
e. Te – econom plus (IVOCLAR VIVADENT)
f. Self- Etch adhesive – G-Bond
g. Light- Emitting diode-Monitex, Taiwan.
h. Instron- Universal Testing Machine

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A total of 30 acrylic blocks are prepared using the cuboidal mould (30mm X 20mm) in dimension. In each of the block- well of 6 mm diameter and 2.5 mm depth is prepared by drilling holes to retain the GIC &RMGIC. Grooves are placed on the walls for extra retention. The 15 wells are filled with GIC & other 15 are filled with RMGIC and covered with glass plates to produce smooth surface for 40 secs, and the RMGIC is light cured as per manufacturer's instructions. Then the specimens are randomly divided to 6 groups-5 specimen each. Group A1-To the RMGIC a thin layer of the Self etch adhesives (G-Bond) is applied and cured and then a cylinder of the Composite resin-FILTEK P60 (3M ESPE, St Paul U.S.A) is added to a height of 5mm and cured over the specimen. Group B1- Same as the Group-A1 but tetric n-Ceram cylinder is added and cured Group C1- same as Group A but te - econom plus cylinder is added and cured, Group A2 – to the GIC a thin layer of self etch (G-Bond) is applied and cured and then a cylinder of composite resin FILTEK P60 (3M ESPE) is added and cured. Group B2 - Same as group A2 but tetric n-Ceram cylinder is added and cured, Group C2 – same as group A2 but te – econom plus cylinder is added and cured. The bonded specimens are stored in the distilled water for 24 hours to stimulate the oral cavity. The shear bond strength is measured by shearing of the bonded specimen on an Instron universal testing machine using a cross head speed of 0.05/minute. The readings are tabulated and subjected to the statistical analysis.

Figure 1: Instron universal testing machine (model 4406)

OBSERVATIONS AND RESULTS

The mean shear bond strength of each group with RMGIC was compared to the mean shear bond strength of its corresponding group with GIC and following results were achieved.

Table 1: Comparison of shear bond strength of RMGIC and GIC in groupA1 and A2, Filtek P60 (Student's paired t test)

Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
RMGIC A1	3.85	5	0.12	0.05
GIC A2	1.83	5	0.10	0.04

Student's paired t test

Paired Differences					t	df	p-value
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
2.02	0.22	0.09	1.74	2.29	20.28	4	0.000 S,p<0.05

Table 1 shows the comparison between the mean shear bond strength of Filtec P 60 to RMGIC group A1 and GIC group A2 and when students paired t test was used it showed statistically significant higher bond strength between that of RMGIC and Filtec P 60 group A1.
Table 2 shows the same comparison between shear bond strength of Tetric-n Cream with that of RMGIC group B1 and GIC group B2. Group B1 showed statistically significant higher bond strength.

Table 2: Comparison of shear bond strength of RMGIC and GIC in group B1 and B2, Tetric-n Cream
(Student's Paired t test)Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
RMGIC	3.23	5	0.06	0.03
GIC	1.72	5	0.21	0.09

Student's Paired t test

Paired Differences							
Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**p-value**
			Lower	**Upper**			
1.50	0.24	0.10	1.20	1.80	13.95	4	0.000 S,p<0.05

Table 3 shows the comparison between mean shear bond strength of Te- Econom plus with that of RMGIC group C1and GIC C2, it was seen that group C1 showed statistically significant higher bond strength.

Table 3: Comparison of shear bond strength of RMGIC and GIC in group C1 and C2, Te – econom plus
(Student's paired t test)Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
RMGIC	3.23	5	0.19	0.08
GIC	1.83	5	0.04	0.02

Student's Paired t test

Paired Differences							
Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**p-value**
			Lower	**Upper**			
1.39	0.23	0.10	1.10	1.68	13.27	4	0.000 S,p<0.05

Graph 1 shows the diagrammatic representation of the results obtained of mean shear bond strength in different groups and groups with common composite resin are paired to show difference in their values for mean shear bond strength

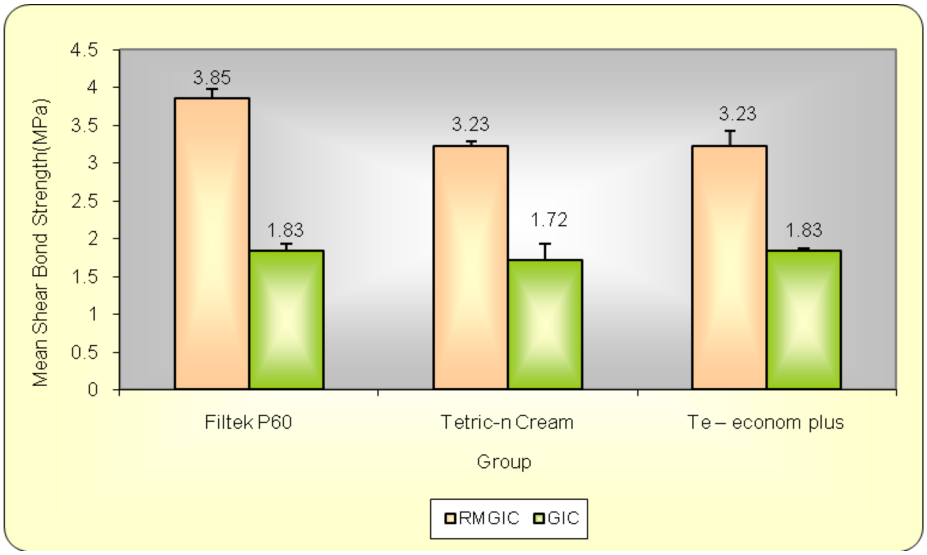

Figure 2: Comparison of RMGIC and GIC in group Filtek P60 A1 and 2, Tetric-n Cream B1 and 2 and Te – econom plus C1 and 2

Table 4: Comparison of RMGIC with Filtek P60, Tetric-n Cream and Te – econom plus (Tukey test)

Descriptive Statistics

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Min	Max
Filtek P60	5	3.85	0.13	0.05	3.69	4.01	3.65	3.99
Tetric-n Cream	5	3.23	0.06	0.03	3.14	3.31	3.13	3.30
Te – econom plus	5	3.23	0.19	0.08	2.99	3.47	2.93	3.42

Multiple Comparisons: Tukey Test

		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval Lower Bound	Upper Bound
Filtek P60	**Tetric-n Cream**	0.62	0.08	0.000 S,p<0.05	0.38	0.85
	Te – econom plus	0.62	0.08	0.000 S,p<0.05	0.38	0.85
Tetric-n Cream	**Te – econom plus**	0.00	0.08	1.000 NS,p>0.05	-0.23	0.23

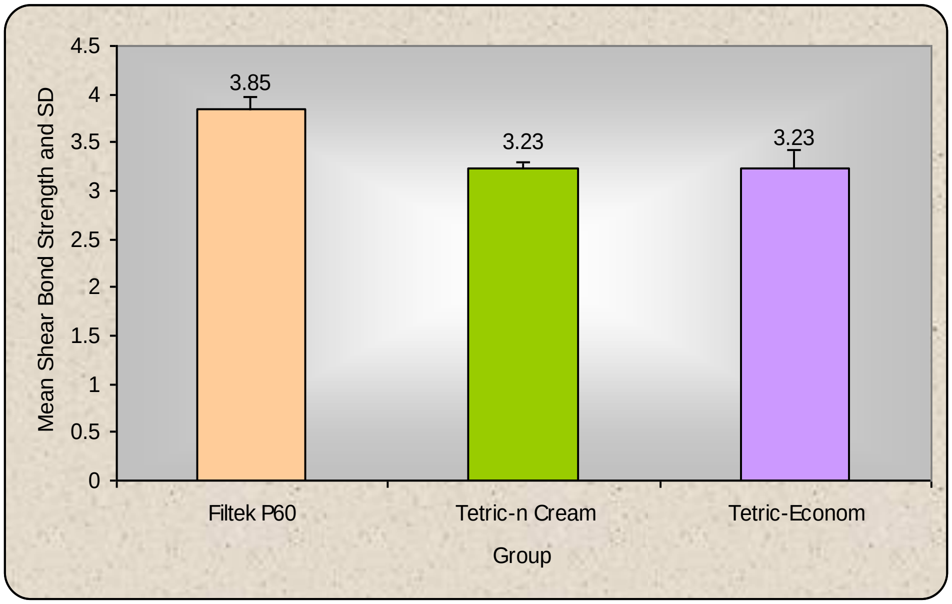

Figure 4: Comparison of RMGIC with Filtek P60, Tetric-n Cream and Te – econom plus

From the above results it was found that in each group the one with RMGIC scored a higher mean shear bond strength than their corresponding groups with GIC.
Another statistical analysis was done (multiple tukey test) to compare the mean shear bond strength of RMGIC with that of different composite resin i.e comparison was done between A1, B1 and C1. It was found that A1 showed statistically significant higher bond strength compared to B1 and C1. But B1 and C1 did not show any statistically significant difference in their mean shear bond strength table 4 and graph 2.

DISCUSSION

In the present study RMGIC showed higher mean shear bond strength over conventional GIC under composite resin restoration because RMGIC sets by an acid–base reaction and exhibits a command set when activated by light or chemical agents via the methacrylate group. RMGIC has also demonstrated a better bonding to composite resin than the conventional GIC (Farah, 1998). This is due to a similar chemistry between RMGIC and the composite resin, which allows the strong bonding of RMGIC to composite resin. Both RMGIC and the resin composite are cured by a free radical initiator system, which provides a potential for the chemical bonding between these two materials. Several mechanisms are thought to be involved in the chemical adhesive bond between resin-modified glass ionomers and resin composites. Increased availability of unsaturated double bonds in the air inhibited layer of the resin-modified glass ionomer cements may assist in the chemical bonding to the resin bonding agent and resin composite (Kerby, 1992). Unsaturated methacrylate pendants which are available on the polyacid chain within the polymerized resin-modified glass ionomer cement may also form covalent bonds with the resin bonding agent (Wilson, 1990). If the ‘sandwich’ restoration is to succeed clinically, a chemical bond would be preferable to a micro-mechanical one, since an adhesive bond would be more stable over time, and less likely to separate under load.

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