International Journal Of

Recent Scientific Research

ISSN: 0976-3031

Volume: 7(6) June -2016

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THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
http://www.recentscientific.com/ recentscientific@gmail.com

ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 7, Issue, 6, pp. 12098-12101, June, 2016

International Journal of Recent Scientific Research

Research Article

EFFECT OF ACID ETCHING ON TENSILE BOND STRENGTH OF COMPOSITE RESIN WITH DIFFERENT TYPES OF GLASS IONOMER CEMENTS

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ARTICLE INFO

Article History:

Received 17th March, 2016
Received in revised form 21st April, 2016
Accepted 06th May, 2016
Published online 28th June, 2016

Key Words:

Glass ionomer, Tensile bond strength, Composite resin, Acid etching

ABSTRACT

Aims & Objectives: To compare the effect of acid etching on the tensile bond strength of composite resin to various glass ionomer cements.
Materials and Methods: Sixty extracted molars (maxillary and mandibular) were prepared for this study by flattening all the cusps to give the shape of the crown as a block. These sixty samples were divided in six groups having ten samples in each group. They were as follows: Group 1- Conventional GIC with acid etching, Group 2- Conventional GIC without acid etching, Group 3- Light cured RMGIC with acid etching, Group 4- Light cured RMGIC without acid etching, Group 5- Self cured RMGIC with acid etching, Group 6- Self cured RMGIC without acid etching.
Results: The results showed no significant differences between any of the six groups, showing that application of 37% phosphoric acid did not result in significant bond strength between Glass Ionomer cement and composite resin.
Conclusion: Acid etching by 37% phosphoric acid on glass ionomer cement surface did not improve the tensile bond strength of conventional, light cured resin modified and self cured resin modified glass ionomer cement to composite resin.

INTRODUCTION

Esthetics has become the prime concern of the individuals nowadays and a beautiful smile is all that we need for a charming personality. Therefore, various esthetic materials have evolved over the time. The extensive range of tooth color materials for esthetic restorations in the market are mainly branches of two separate groups that are glass ionomer cement (GIC) and composite resin each with its own sub groups.

In 1972, Wilson and Kent was the first to introduce glass ionomer cement in the dental market. The original glass ionomer cements became well known for their fluoride releasing property, biocompatibility and ability to bond with hydroxyapetite crystals, but their overall strength, wear resistance, esthetics and multiple physical properties were not adequate for use in any stress bearing regions in the mouth [1], while the composite resins were introduced in the late 1960s, till then, they have gained general respect due to their esthetically pleasing appearance and stability within the environment, however they have several disadvantages such as polymerization shrinkage, potential failure of adhesion leading to secondary caries and a relatively high coefficient of thermal expantion.[2,3]

To derive the benefit of both the materials, bonding composite restorative material to etched glass ionomer cement, the so-called sandwich technique was proposed by McLean *et al*. (1985). The principal manner of attachment of composite resins to glass ionomer cement is by mechanical interlocking.[4,5] Acid etching of the cement surface creates a mechanical interlocking because it causes considerable surface roughness by loss of matrix and the exposure of glass particles.[6,7,8,9] Surface roughness is dependent on etching duration and cement maturity before acid etching.[6,10]

The superior micromechanical bond of resin composite to acid-etched enamel, the bond strength of glass ionomer to dentin and the ability of glass ionomer to release fluoride when in contact with oral fluids, combined with its low solubility, make the combination of these two materials a prudent step in improving clinical success.[11,12]

The bond strength between glass-ionomer cement and composite resin is certainly important for both the retention of the resin restoration and prevention of microleakage. Although the need for enamel and dentin pre treatment has been well-established in the literature, the need for surface treatment

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over the GIC before composite resin lamination in sandwich restorations remains controversial.[13]

MATERIALS AND METHODS

Sixty extracted molars of patients visiting the department of Oral and Maxillofacial Surgery at H.K.E. Society's S. Nijalingappa Institute of Dental Sciences And Research, Gulbarga, Karnataka were collected. All the extracted teeth had been cleaned of deposits using an ultrasonic cleaner and stored in 10% formalin, storage period being less than one month. All the cusps of the molars were flattened to give the shape of the crown as a block. A hole was prepared at the center of each block with a no 2 round bur which was of 2 mm depth and 6 mm diameter. Sixty samples were divided into six groups having ten samples in each group. They were as follows: **Group 1**- Conventional GIC with acid etching, **Group 2**- Conventional GIC without acid etching, **Group 3**- Light cured RMGIC with acid etching, **Group 4**- Light cured RMGIC without acid etching, **Group 5**- Self cured RMGIC with acid etching, **Group 6**- Self cured RMGIC without acid etching. For each group glass ionomer restoration was done and smoothened using a cup shaped polishing disc. For groups which required acid etching, they were etched with 37% phosphoric acid gel. After etching they were rinsed with water spray for 30 seconds. Bonding agent was applied on the GIC samples and cured for 30 seconds. A plastic straw of 4 mm diameter and 1 cm length was attached at the center of each GIC samples which was previously lubricated with Vaseline in its inner surface for easy removal. 2 mm increments of composite resin was placed through this plastic straw and condensed well on the GIC surface, later which was cured for 40 seconds. Additional composite resin was condensed to fill the straw and each of the increments were cured for 40 seconds. After curing, the plastic straw was removed. The samples were tested in universal testing machine at a cross speed of 6mm per minute. The test specimens were loaded at tension to failure and the tensile bond strength was recorded from the load required to cause debonding divided by area of the adherent surface.

RESULTS

Statistical analysis showed the following results as depicted in the subsequent tables and graph.

Table -1 Mean and Standard deviation (SD) of Tensile Bond Strength and t value for comparison between with & without acid etching by unpaired student 't' test.

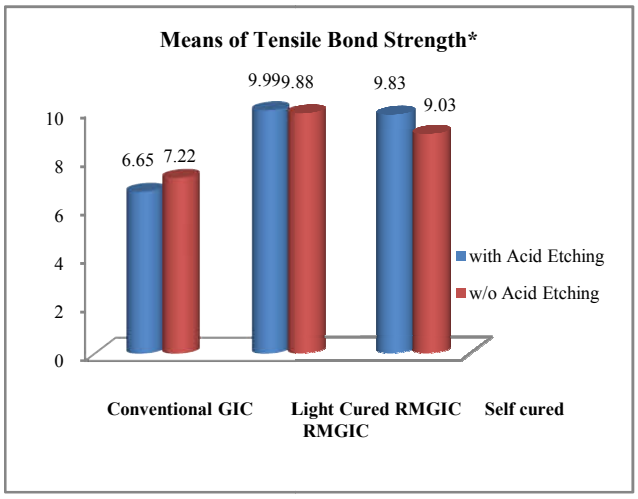
	Conventional GIC		Light Cured GIC		Self cured resin modified GIC	
	with Acid Etching	without Acid Etching	with Acid Etching	without Acid Etching	with Acid Etching	without Acid Etching
Mean	6.65	7.22	9.99	9.88	9.83	9.03
SD	1.13	1.79	0.53	1.79	4.19	1.51
T value	1.51(p=0.0742) is not significant		0.19(p=0.4257) is not significant		0.54(p=0.2979) is not significant	

Table -2 Comparison of Tensile Bond Strength between groups, for with Acid Etching by One way ANOVA

Variation	d.f	Sum of squares	Mean sum of squares	F value
Between groups	2	70.9918	35.4959	5.00
Within groups	27	191.6616	7.0986	

Table -3 Comparison of Tensile Bond Strength between groups, for without Acid Etching by One way ANOVA

Variation	d.f	Sum of squares	Mean sum of squares	F value
Between groups	2	23.5482	11.7741	3.64
Within groups	27	87.3406	3.2348	



Graph-1

*All the values were measured in Mpa.

Interpretation

1. In Table 1, t value < 1.73 or p value > 0.05 shows no significant difference.
2. In Table 2 & 3, f value>3.35 shows significant difference for p=0.05.

DISCUSSION

Tensile strength is subjected to two sets of forces that are directed away from each other in the same straight line. The load tends to stretch or elongate a body. In this study the tensile bond strength of conventional, light cured and self cured resin modified glass ionomer cement to resin composite was measured. Dislodgement of composite resin may be possible from glass ionomer cement in a sandwich restoration with some sticky foods when the force crosses the limit of the tensile bond strength between glass ionomer cement and composite resin.

The union between the glass ionomer cements to composite resins has been exhaustedly studied, and research shows that the light-curing ionomer cements possess significantly higher bond strength to composite resin than any of the chemically curing cements.[14]

In this study molars (maxillary and mandibular) were selected as the occlusal surface of the molars have more surface area compared to other teeth in the oral cavity. Usage of larger surface area was for restoration with GIC, improved etching, bonding, attachment of plastic straws and bonding of composite resin with GIC.

In our study, after statistical analysis using unpaired student 't' test, within the subgroups, the tensile bond strength, of the specimens which were acid etched with 37% phosphoric acid and which were not etched, was not significant. There was no significant change in the bond strength of the

specimens, after acid etching the glass ionomer cement and without etching.

The means of the tensile bond strength, with acid etching and without acid etching were 1) Conventional GIC with and without etching (6.65Mpa/7.22Mpa), 2) Light cured RMGIC With and without acid etching (9.99Mpa/9.88Mpa) 3) Self cured RMGIC with and without acid etching (9.83Mpa/9.03Mpa). The result obtained, etching the GIC surfaces with 37% phosphoric acid and without etching with the same, was not significant.

Similar types of results were published by many of the investigators. This study was in agreement with Mesquita *et al*.(1999) and Joynt RB *et al*.(1989) who suggested reports concluding that there was no improvement of tensile bond strength with or without acid etching between glass ionomer cement and resin composite.[15,16]

These results obtained were in agreement with Sabah *et al*. [17], Kerby and Knobloch [18], Amin *et al* [19], and Zanata [20] *et al* since the etching of the ionomer surface did not result in a significant improvement in the bonding of glass ionomer cement (conventional and resin-modified) to the composite resin. These results were in contrast to earlier short term experimental studies, where in past research, there was no consensus on the necessity of acid-etching over the glass-ionomer surface to improve the bond strength with composite resin.[21,22,23]

McLean *et al* (1985) advocated the etching procedure for 60 seconds to obtain closer contact and mechanical interlocking between the bonding agent and the porosity created by acid-etching of the cement surface. However, some investigators have rejected the acid-etching procedure, since it leads to a decrease in the cohesive strength of the cement.[23,24] Sheth, *et al* (1989) suggested that acid-etching of the glass-ionomer cement would only undermine the cement surface, and hence cohesive failure of this weakened zone would be determined instead of a "true" interfacial resin bond strength.[24]

Researchers, who even suggested the etching procedure, have not reached a consensus on standardizing the etching time yet. Some authors have restricted the etching process to 15 seconds because the surface deterioration of the cements occurs with a prolonged etching time[25]. There are studies recommending 30 and/or 60 seconds of etching time for a desirable bonding effect.[27,15,23] However, when the "etch & rinse" system was used, 30 seconds seemed to be the optimal etching time of 37% phosphoric acid for both the conventional GIC and resin modified GIC. The findings of this study were not in agreement with those of other studies [3,27,28,29] which have suggested that the etching process did not improve the bond strength of the resin composite to the glass ionomer cement. Pamir *et al*. (2012) did not observe any statistical differences between the "no etch" and the specimens etched with 15 seconds etching time.

The need for surface treatment of the GIC before the placement of laminate restorations remains debatable. While some studies have found that aggressive acid etching improved the bond strength of GIC to resin composite by forming a rough and porous surface to allow the infiltration of the bonding resin to form a GIC hybrid-like layer, [22,30] other studies have found no consistent bond improvement [25,31] and some reported a decrease in bond strength.[8]

Comparing the tensile bond strength with acid etching and without etching (Table 2 and 3, One way ANOVA) between three main groups that are conventional GIC, light cured GIC and self cured resin modified GIC, there was significant changes in the bond strength for each of the materials with resin composite. Light cured glass ionomer showed highest value of tensile bond strength than conventional glass ionomer and self cured resin modified glass ionomer.

Lamination over the resin modified GIC seems to be more effective, since the bond strength of the resin composite to the resin modified GIC was significantly higher compared with that of the conventional GIC. This was in agreement with the results of previous reports.[20,32] It has been suggested that a similarity in compositions of both materials and curing mechanisms by the free-radical initiator system might be responsible for the increased bond strengths.[33,34,35]

The higher bond strengths of light cured GICs to resin composite could be the result of the curing process which according to the manufacturer is three-fold. Firstly, an acid/base reaction identical to that of conventional glass ionomer cements; secondly, a light-activated free radical polymerization of methacrylate groups of the polymer and HEMA initiated by visible light; and thirdly, a water activated redox catalyst reaction which allows the methacrylate cure to proceed in the dark.[17,36]

CONCLUSION

From the limitations of this study, conclusion can be given that, it is better to use resin modified glass ionomer cement as a liner under composite resin in sandwich technique and for the maximum tensile bond strength with resin composite, it should be used with light curing mode.

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TSSN 0976-3031