



FLOURIDE RELEASE FROM CONVENTIONAL GLASS IONOMER CEMENT COATED WITH DIFFERENT BONDING AGENTS - AN IN VITRO STUDY

Dental Science

Pallavi .P. Jhawar	2 nd year Post Graduate student Department of Pediatric & Preventive Dentistry Guided by Dr. Ruchi .V. Arora Darshan Dental College & Hospital. Ranakpur road Udaipur, Rajasthan.
Ruchi .V. Arora*	Professor & Head of the Department of Pediatric & Preventive Dentistry Director, PG Studies Darshan Dental College & Hospital Udaipur, Rajasthan. *Corresponding Author
Juhi .P. Mehta	2 nd year Post Graduate student Department of Pediatric & Preventive Dentistry Darshan Dental College & Hospital. Udaipur, Rajasthan.
Piyush .H. Kalsariya	2 nd year Post Graduate student Department of Pediatric & Preventive Dentistry Darshan Dental College & Hospital. Udaipur, Rajasthan.

ABSTRACT

Aim: To know the effect of surface protective agents on the fluoride release property of GIC – An in Vitro Study.

Method: sixty premolars were collected and divided into three groups, twenty in each. Group I: Uncoated, Group II: Petroleum jelly, Group III: Resin bonding agent. Class I cavity was prepared and restored with GIC on tooth samples. According to the groups division, samples were coated and stored in coconut water which was changed after every 24 hours for fifteen days to measure the fluoride release.

Statistics & Result: The data was subjected to one-way ANOVA with the level of significance set at 0.05 ($P < 0.05$). The greatest amount of fluoride was released from the petroleum jelly group, followed in ranking by uncoated and bonding agent.

Conclusion: Application of petroleum jelly can be used as coating for significant release of fluoride

KEYWORDS

Fluoride, coating, GIC

INTRODUCTION

Dental caries is a prevalent chronic disease, which particularly affects young children. Glass ionomers used preferentially in the treatment of primary caries and for replacement of restorations. Glass-ionomer cement has replaced silicate cement and clinical experience indicated that fluoride release from glass ionomer provides a reduction on secondary caries.^{1,2} Conventional glass-ionomer materials have shown to inhibit secondary caries formation on the tooth surface and along the tooth/restorative interface. The need for immediate protection of the freshly mixed cement from moisture contamination is experienced.¹ A more interactive role of fluoride in the dynamic biological environment includes the formation of calcium fluoride, reduced hypersensitivity, osteoblast proliferation, and firmer bone anchorage.⁵ The anticariogenic effect of fluoride releasing restorations depends on the amount of released fluoride and obviously even more on the longevity of this release. Release of fluoride is under the influence of some internal variables such as matrix formulation, filler, and fluoride content.³ Today, there are several fluoride-containing dental restoratives available in the market including glass-ionomers, resin modified glass-ionomer cements, polyacid-modified composites (compomers), composites and amalgams. Due to their different matrices and setting mechanisms the products vary in their ability to release fluoride.⁶ However, it is assumed that the antibacterial and cariostatic properties of restoratives are often associated with the amount of fluoride released.

The high powder to liquid ratio in Ketac Molar gives it excellent strength yet allows fluoride release and recharge to take place, enabling remineralization of the adjacent tooth substrate.⁸ Hence, the present study aim is to know the effect of surface protective agents on the fluoride release property of GIC.

MATERIAL AND METHOD

Freshly extracted premolars were collected and stored in sodium hypochlorite solution. Ketac Molar GIC (3M ESPE) was chosen for this study. Class I cavity was prepared on the collected sample according to standardized measurements. GIC was mixed according to manufacturer instruction and the tooth were restored with it. Any excess material was removed and polishing of the surface was done. Immediately after restoration, the samples were divided into three groups according to the surface coating: Group I – Uncoat, Group II – Petroleum Jelly, Group III – Resin Bonding Agent. After coating, the samples were immersed in coconut water to simulate the oral conditions. These were then left undisturbed in an incubator set at

37°C. After 24 hours, the bottles were removed from incubator and the tooth samples were grasped with clean metal forceps coated with nail varnish and washed with 1 ml of deionized water using a syringe, over the original holding bottle. After 24 hours, the samples were washed under distilled water and then transferred to new sealable bottle. The coconut water was changed every 24 hours and release of fluoride was measured for 15 days. Fluoride release was determined after buffering the solution with equal volumes of total ionic strength adjustment buffer (TISAB II), Orion Research, Inc, Beverly, MA, USA). Fluoride release was measured with a combination of fluoride electrode (Orion 9609BN, Orion Research Inc) and an ion analyzer (Orion EA 940, Orion Research Inc). Data concerning fluoride was recorded in parts per million (ppm). Statistical analysis was carried using software version Systat 10.0, and the data was subjected to one-way ANOVA, using Duncan Multiple Range test (Variable LSD) with the level of significance set at 0.05 ($P < 0.05$).

RESULTS

- All the three groups of GICs evaluated for the fluoride release during the entire period of the experiment.
- Total fluoride release from the restorative material is tabulated in Table 1
- The greatest amount of fluoride was released from the petroleum jelly group, followed in ranking by uncoated and resin bonding agent coat and the difference among them was statistically significant in Figure 1

Table 1: Mean fluoride release (in ppm) from GIC with or without surface coatings at different time intervals in coconut water

	Fluoride release from control specimens in ppm (Mean $\pm$ SD)	Fluoride release from resin bonding coated specimens in ppm (Mean $\pm$ SD)	Fluoride release from petroleum jelly coated specimens in ppm (Mean $\pm$ SD)	P-Value
Day 1	13.22	0.7	10.27	$P < 0.05$
Day 2	10.48	0.6	9.32	$P < 0.05$
Day 3	8.35	0.55	9.11	$P < 0.05$
Day 4	7.25	0.4	8.77	$P < 0.05$
Day 5	6.32	0.35	8.42	$P < 0.05$
Day 6	5.34	0.23	8.26	$P < 0.05$
Day 7	4.26	0.20	7.72	$P < 0.05$

	Fluoride release from control specimens in ppm (Mean $\pm$ SD)	Fluoride release from resin bonding coated specimens in ppm (Mean $\pm$ SD)	Fluoride release from petroleum jelly coated specimens in ppm (Mean $\pm$ SD)	P-Value
Day 8	3.74	0.17	7.19	$P < 0.05$
Day 9	2.57	0.15	6.14	$P < 0.05$
Day 10	2.48	0.11	5.12	$P < 0.05$
Day 11	2.13	0.09	4.07	$P < 0.05$
Day 12	1.98	0.08	3.52	$P < 0.05$
Day 13	1.85	0.08	3.11	$P < 0.05$
Day 14	1.75	0.07	2.43	$P < 0.05$
Day 15	1.70	0.07	2.11	$P < 0.05$

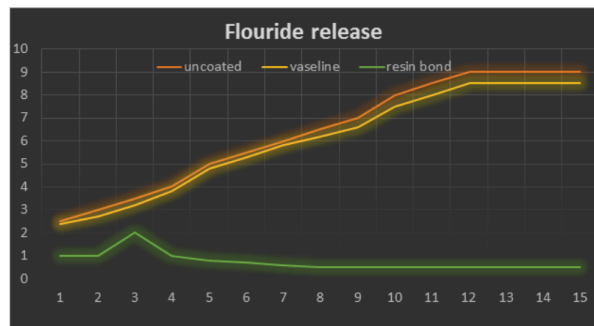


Figure 1: Mean fluoride release (in ppm) from GIC with or without surface coatings at different time intervals in coconut water

DISCUSSION

The ability to take up and re-release fluoride to the oral environment when restorative materials are exposed to fluoridated products such as toothpaste, mouthwash and fluoride gel, is an important property of some restorative materials.² When some restorative cements are exposed to topical fluoride, fluoride diffuses into the matrix material, increasing its reservoir of fluoride, from which it is subsequently and slowly leached to the oral environment or medium in which the restorative material is stored.¹⁴ In this study we investigated rate of fluoride release from three different restorative material on coating.

In our study The conventional glass-ionomer Ketac Molar released considerably less fluoride compared with Vitremer and F-2000. This may be explained by its low solubility and high power to liquid ratio (3:5:1). The manufacturers had reported a 24-h total solubility of 0.05% when samples of Ketac-Molar were placed in water after an hour (Product Literature from ESPE, 1996).⁵

Recent study by Kamantha and Reddy 2019 showed that despite the wide variations in the amounts of fluoride released, the pattern of release remained consistent irrespective of the surface coating.⁹ Our present study is similar to this finding, stating there was an initial burst of fluoride release followed by low, prolonged elution.

Chau NPT *et al* (2015) concluded that the acid production rate of *S. mutans* biofilms on GICs followed a negative linear-pattern of fluoride release rate-dependence during biofilm formation.¹¹ Ketac molar GIC in the present study showed that the acid production of biofilms decreases as fluoride release rate increases during biofilm formation.

In the current study uncoated group revealed more fluoride release as compared to the coated group and among the coated group petroleum jelly followed by resin bonding agent.

Fluoride release through a bonding resin also means that it may be suitable to place a light-cured bond coating over a conventional GIC restoration to protect it against moisture uptake and loss during initial setting.⁴ This will permit fluoride ions to be released into the oral environment for uptake, either by adjacent teeth or by saliva. Petroleum jelly shows some improvement in surface hardness and reduced ion leaching compared with those uncoated group stored in coconut water. It may also justify placing a dentine adhesive under a fluoridated resin composite restoration, in a procedure that will not completely inhibit the fluoride release around the cavity walls, although the quantities of fluoride available will be less. Further studies are needed to clinically corroborate these findings.

Mazziou, Burrow and Tyas (2000) compared the effect of surface coatings on patterns and amounts of fluoride released from four glass ionomer cements and two fluoride-containing resin composites concluded that fluoride release was not completely hampered after coating on either of the restorative material although amount was significantly less.⁴ The coated samples in the present study released between 45–78% less fluoride than the uncoated samples.

Recent systemic review by Heintze *et al.* 2018 showed that fracture toughness being mostly correlated with clinical fracture of composite resins and no correlations were observed between clinical outcomes and flexural modulus or flexural strength of these materials. Samples of resin composites were apparently more affected by the coating, because the release of fluoride was found to be between 91 and 96% less than from uncoated samples.¹³

It has been pointed out that the higher the viscosity and thickness of the surface coating, the greater the barrier against fluoride release

CONCLUSION

1. Application of resin bonding agent over GIC can severely impede its fluoride release property
2. Application of petroleum jelly also impedes the fluoride release, but to a very less extent.
3. In situations where the fluoride release property is more important than other properties it is better to coat the GIC with petroleum jelly or leave the restoration without any coating.

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