Sys Rev Pharm 2020; 11(2): 440 – 443
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

Effect of Increased Fluoride Contents on Fluoride Release from Glass Ionomer Cements.

Monadle R. Hadi*
Dentistry College in Al-Kafeel University
E-mail: monadle.almansoor@alkafeel.edu.iq

Article History: *Submitted: 18.11.2019* *Revised: 28.01.2020* *Accepted: 26.02.2020*

ABSTRACT
Background: Because of chemical bonding and fluoride release to the surrounding tooth structure, glass ionomer cement has been used as a restorative material for its. This study aims to investigate if boosting fluoride contents in cement powder can increase the fluoride that is released from the set cement.
MATERIALS & METHODOLGY: Two types of cements have been prepared with the excess fluoride contents: cement (1) as the conventional chemical-cured, and cement (2) as the light-cured resin-modified glass ionomer cement. Two commercial cements were used for comparison, cement (3) has been chemically-cured (RIVA), and cement (4) has been light-cured (RIVA). For each type of cement, there were five specimens used in the shape of discs with 6mm diameter and 3mm height. The specimens were submerged in artificial saliva solution for periods of 1 day, 1week, 2 weeks, 1 month and 2 months. The number of fluoride ions, which were released in the saliva solution has been measured by a specific fluoride ion electrode connected to an ion-analyzer.
RESULTS: The test components (1 and 2) have indicated that fluoride release is more than the commercial cements (3 and 4). The whole amount of fluoride release from the resin-modified cement (2) was more than the conventional cement (1) throughout the test period.
CONCLUSSION: The prepared cements' fluoride release was higher than the commercial cements. Increasing fluoride percentage within the cement formula has led to increase fluoride release of the set cement.
Key words: ionomer cement, fluoride, release.
Correspondence:
Monadle R. Hadi
Dentistry College in Al – Kafeel University
E-mail: monadle.almansoor@alkafeel.edu.iq
DOI: 10.5530/srp.2020.2.65

INTRODUCTION

One of the important advantages of glass ionomer cement restorative material is the release of significant levels of fluoride ions into the surrounding tooth structure and into the oral environment. (1)

The amount of constant fluoride release did not differ much between brands of conventional glass ionomer cements. (2)

It had been reported by Neelantan et al. that the presence of light-activated resin does not hinder the fluoride release from light-activated glass-ionomer cement (3).

* Lecturer: department of conservative dentistry, college of dentistry, university of Alkafeel.

The amounts of fluoride ions released by resin-modified glass ionomer cements are, at least, equal to those released by conventional glass ionomer cements but varies amongst different commercial products. (2)

Momoi and McCabe (1993) have emphasized that "resin-modified glass ionomer cements had a potential for releasing fluoride equivalent to that of conventional cements." (4)

Cary et al (2003) found that the glass ionomer cements have indicated significantly higher initial fluoride release rates during the first day. After the first two days, fluoride release rates have decreased fast and become essentially stabile within 3-5 weeks, in an exponential mode. (5)

Fluoride ion is released as a consequence of the acid-base reaction of glass ionomer cement. Fluoride does not involve in acid-base setting reaction and remains free within the polyacrylate salt matrix. (6)

The glass particles contain up to 23 percent fluoride, some of which will be released from the glass, mainly in the form of sodium fluoride. Increasing the fluoride contents within the glass mixture may increase the amount of fluoride released from glass ionomer restoration. (7, 8, 9)

The aim of this work was to compare the amounts of fluoride released from two glass ionomer cements containing increased fluoride contents with two commercially available.

MATERIALS & METHODOLOGY

The solid part or powder of glass cement consisted mainly of silica (SiO_2), alumina (Al_2O_3), and calcium fluoride (CaF_3). Other minor constituents were added such as cryolite (Na_3AlF_6) to lower the fusion temperature of the powder mixture.

This powder was modified to produce a new formula by making total fluoride contents 29 % (table 1).

The liquid for the tested cements was prepared from the aqueous solution of Polyacrylic acid in a concentration of 50%. The ratio of the ingredients used is presented in tables (2 and 3). Maleic acid is also used, as a white powder, to form a copolymer with Polyacrylic acid, and to prevent increased viscosity of the acid by time. Tartaric acid was also added, the materials were mixed until the powder acid particles were dissolved and water was finally added. Hydroxyethylmethacrylate (HEMA) material as a liquid was added to the liquid of resin modified type of prepared cements, and the ratio of HEMA shown in table (2).

Table 1: Components of glass powder.

Material	Weight(gram)	Weight%
SiO_2	70	37
Al_2O_3	40	21
CaF_3	40	21
Na_3AlF_6	15	8
$AlPo_4$	24	13

Table 2: Components of liquid for light- cured types of cement.

Material	Fraction ratio
Polyacrylic acid	3
Maleic acid	1
Hydroxyethylmethacrylate	2
Tartaric acid	1

Table 3: Components of liquid for chemical-cured cement.

Material	Fraction ratio
Polyacrylic acid	3
Maleic acid	1
Tartaric acid	1

Two types of glass ionomer cements were produced, the first was conventional chemical- cured (cement 1), and the second was resin-modified light-cured (cement 2).
Two commercial cements were used for comparison purposes. First one was chemical-cured cement (3), and the second one was light-cured cement (4) table (4).

Table 4: Types of cements used in the study.

Cement No.	Type of cement
1	Conventional Chemical-cured
2	Resin-modified light- cured
3	Commercial (RIVA from SDI) conventional chemical-cured
4	Commercial (RIVA from SDI) resin-modified light-cured

Twenty disc shaped specimens with dimensions of 6mm diameter and 3mm height were prepared in molds which were made from heavy body of polysilicone impression material.
Specimens for light cured cements they were mixed in 3:1 powder/ liquid ratio by weight for 30 seconds and packed in to the molds. Immediately both sides of the mold were light-cured, for 60 seconds from both sides. Ten light cured disc shaped specimens were produced with five specimens for each type of light-cured cements.
For chemical-cured cements, the materials were mixed to the same powder/ liquid ratio for 30 seconds and packed into the molds.
Celluloid strips with glass slabs from both sides were applied and the material was allowed to harden inside the molds for 60 minutes. Ten chemical cured specimens were produced with five specimens for each type of chemical-cured cement. After hardening, celluloid strips were removed. All specimens then removed, the ends or margins of the specimens were finished. The specimens were then stored in a humid atmosphere for 24 hours in an airtight plastic containers.
Each specimen was left suspended inside the container without touching the base. Each polyethylene container was filled with 20 milliliters of artificial saliva solution. The composition of artificial saliva is presented in table (5).

Table 5: Composition of artificial saliva.

Material	Weight (gram)
NaCl	0.7
KCl	1.2
KSCN	0.33
$NaHCO_3$	1.5
Na_2HPO_4	0.26
KH_2PO_4	0.2

The glass ionomer specimens were left suspended in the saliva solution in closed containers stored at room temperature (25ºC) ± 2.
Five specimens from each type of cement were left in saliva solution for different immersion times (24 hours, one week, two weeks, one month, and two months).

Table 6: Fluoride ion release (ppm) in artificial saliva for different immersion times.

Type of cement	one day	One week	Two weeks	One Month	Two Months
1	21	25	27	39	17
2	30	29	38	12	24
3	1	2	4	2	3
4	4	4	12	4	5

The specimens were removed from the saliva solution at the end of each immersion time, and the amount of fluoride ions released was measured after collection of stored saliva solutions.
Fluoride ion release was measured at one day, one week, two weeks, one month and two months. The measurement was made by fluoride ion specific electrode connected to an ion-analyzer, both manufactured by Orion Research Inc. (USA).

Values were recorded and calculated according to the calibration curve.

RESULTS

Fluoride ion release from the glass ionomer cement samples in artificial saliva for different periods of immersion is presented in table (6). Generally, the experimental cements (1 and 2) showed increased amounts of fluoride release than commercial cements (3 and 4).

Cement (1) showed gradual increase of fluoride ion release until it reach the maximum value at one month period then dropped at the end of the test.

Cement (2) showed high level of fluoride ion release at the beginning in the first day, then increased at two weeks period and then dropped at the end.

Cement (3) showed the least amount of fluoride ion release compared with other tested cements.

Cement (4) showed reduced amount of fluoride ion release, compared with cements (1and 2) and the maximum was at period of two weeks.

The maximum amount of fluoride release from the resin-modified cement (2) was more than that of conventional cement (1) through the time of test.

Prepared cements (1 and 2) showed a high initial fluoride release during the first two weeks, and cement (1) had its increased fluoride release till one month duration. While commercial cements (3 and 4) did not show such high initial fluoride release.

DISCUSSIONS

A number of studies have been conducted on fluoride release from dental materials, in which diversity of methods and experimental protocols make it difficult to compare results of different experiments. (10)

Fluoride is released from glass powder while mixing and it lies free within the model. Therefore, if released, it will not affect the physical features of the cements. Nevertheless, the cement may act as a fluoride reservoir over a long period of time, moreover, it can be taken up into the cements during a topical fluoride treatment and released again. In result, it is suggested that glass ionomer cements should be clinically anti-cariogenic. (11)

The fluoride release from different materials evaluated was varied with time. “This means that the pattern and the speed of fluoride release are not similar among various fluoride releasing cements. This discrepancy observed after short and long time which was coincided with the results of our study and confirmed the data related by some authors” (Forsten 1995; Deschepper et al 1991; Friedle et al 1997; Tom, Chan and Yim 1997). (12, 13, 14, 15)

As mentioned by Forsten (1990) that the amount of fluoride released can be affected by the composition of the glass ionomer cement or the type of material that contains the fluoride. (1)

The type and amount of resin used for the light- curing reaction of the resin- modified glass ionomer cements influence fluoride release. (15) According to Mathis and Ferracane (1989), it has been assumed that the resin matrix might firmly encapsulate the fluoride ions and consequently its fluoride release rate into an aqueous environment might be smaller and slower than that of the conventional glass ionomer cements. (16)

The powder/ liquid ratio could also affect the rate of fluoride release. (10, 17) it had been shown that a lower ratio results in increased solubility and fluoride liberation. (18)

The glass powder and liquid composition also play an important role in the fluoride release of the cement. The fluoride content of glass powder probably accounts for this role. (18) Low fluoride release may be due to the low initial content of fluoride which may be due to the replacement of fluoride by other metals like silver or it could be also due to the formation of metal fluoride complex which binds the fluoride ions to the cement, and also it may be due to the sintering process which prevents the saliva or water penetration between metal particles and fluoride releasing matrix. (19)

CONCLUSION

Within the limitation of this study the following conclusions were drawn:

1- Fluoride release of prepared cements was higher than that of commercial cements.
2- Increasing fluoride contents led to increased fluoride release of the set cement into the surrounding tissues.

REFERENCES

1. Norbert Monszner, Ulrich Salz, New developments of polymeric dental composites. Science Direct 2001 26, 4:535-576
2. Mitra SB. In vitro fluoride release from a light-cured glass ionomer liner/ base. Journal of Dental Research 1991; 70: 75-79.
3. P. Neelantan, S. John, S. Anand, N. Sureshbabu and C. Subbarao, Fluoride release from a new glass ionomer cement. Operative Dentistry 2011, 36, 1:80-85
4. Momoi Y, McCabe JF. Fluoride release from light-activated glass- ionomer restorative cements. Dental Materials 1993; 9: 151.
5. C. M. Cary, M. Spencer, R. J. Gove, F. C. Eichmiller, Fluoride release from resin-modified glass ionomer cement in a continuous-flow system: Effect of pH, Journal of Dental Research, 2003.
6. Forsten L. Short and long- term fluoride release from glass ionomers and other fluoride containing filling materials in vitro. Scandinavian Journal of Dental Research 1990; 98: 179- 185.
7. Forss H, Seppa L. Prevention of enamel demineralization adjacent to glass ionomer filling materials. Scandinavian Journal of Dental Research 1990; 98: 173- 178.
8. Mitra SB. In vitro fluoride release from a light-cured glass ionomer liner/ base. Journal of Dental Research 1991; 70: 75-79.
9. Skartveit L, Tveit AB, Totdal B, Ovrebo R, Roadal M. In vivo fluoride uptake in enamel and dentine from fluoride containing material. Journal of Dentistry for Children 1990; 57: 97- 100.
10. Vermeersch G, Leloup G, Verven J. Fluoride release from glass- ionomer cements, compomers and resin

composites. Journal of Oral Rehabilitation 2001; 28: 26- 32.

11. Van Noort R. Introduction to dental materials, 2002: p.137.
12. DeSchepper EJ, Berry EA, Cailleteau JG, Tate WH. A comparative study of fluoride release from glass ionomer cements. Quintessence International 1991; 22: 215.
13. Forsten L. Resin-modified glass ionomer cements: Fluoride release and uptake. Scandinavian Journal of Dental Research 1995; 53: 222.
14. Friedl KH, Schmalz G, Hiller KA, Shams M. Resin modified glass ionomer cements: fluoride release and influence on streptococcus mutans growth. European Journal of Oral Science 1997;105: 18.
15. Tam LE, Chan GP, Yim D. In vitro caries inhibition effects by conventional and resin-modified glass ionomer restoration. Operative Dentistry 1991; 22: 4.
16. Mathis RS, Ferracane JL. Properties of a glass-ionomer/ resin composite hybrid material. Dental Material 1989; 5: 355.
17. Mcknight- Hanes C, Whitford GM. Fluoride release from three glass ionomer materials and the effect of varnishing with or without finishing. Caries Research 1992; 26: 345- 350.
18. Muzynski BL, Greener E, Jameson L, Malone WFP. Fluoride release from glass ionomers used as luting agents. Journal of Prosthetic Dentistry 1988; 60: 41.
19. Itota T, Carrick TE, Yoshiyama M, McCabe JF. Fluoride release and recharge in giomer, compomer and resin composite. Dental Materials 2004; 20: 289-795.