I J Pre Clin Dent Res 2015;2(4):3-6
Oct-Dec

International Journal of Preventive & Clinical Dental Research

A Comparative Evaluation of Fluoride releasing capacity of Three Different Restorative Materials (Conventional Glass Ionomer Cement, Resin Modified Glass Ionomer Cement and poly-acid modified composite) in de-ionized Water and Artificial Saliva: An Ex-vivo study

Abstract

Objective & Aim: This study evaluated the fluoride releasing capacity of three different restorative materials: Conventional Glass Ionomer Cement (GIC), Resin Modified Glass Ionomer Cement (RMGIC) and poly-acid modified composite ($PMCR_S$) in de-ionized water and artificial saliva. **Methods:** Sixty blister packs were prepared of three different restorative materials. Each group consist 10 disc of each material were stored in 6 ml deionized water and 6 ml artificial salvia for 7 days at 37 ^{0}C. Each group consist of one control test tube which contain the solution. The amount of fluoride released was measured at predetermined time intervals of 24 hours during the first day and thereafter on 2nd, 3rd, 4th, 5th and 7th day of the study. **Statistical Analysis:** Comparison of fluoride ion release between different restorative materials was done using Analysis of variance (ANOVA) with post – hoc Games-Howell test. **Results:** There is greater amount of fluoride by all tested material in de-ionized water compared with artificial saliva. The fluoride release is highest in Fuji VII, Fuji II LC and Dyract.

Key Words

Glass ionomer cement; compomer; fluoride ion release; caries control

Prachi Singh[1], Asheesh Sawhny[2], Pushpa S[3], Richa Singh[4], Nitesh Kumar[5], Zowhar Sajid[6]

[1]Lecturer, Department of Conservative Dentistry and Endodontics, MRA Medical College, Ambedkar Nagar, Uttar Pradesh, India

[2]Professor, Department of Conservative Dentistry and Endodontics Rama Dental College, Kanpur, Uttar Pradesh, India

[3]Professor & Head, Department of Conservative Dentistry and Endodontics Rama Dental College, Kanpur, Uttar Pradesh, India

[4]Senior Lecturer, Department of Conservative Dentistry and Endodontics Rama Dental College, Kanpur, Uttar Pradesh, India

[5]Post Graduate Student, Department of Prosthodontics and Crown and Bridge, Sardar Patel Dental College, Lucknow, Uttar Pradesh, India

[6]Post Graduate Student, Department of Oral Medicine and Radiology, Rama Dental College & Hospital, Kanpur, Uttar Pradesh, India

INTRODUCTION

The role of fluoride in preventing dental caries has been well documented. It is well understood fact that fluorides have an anticariogenic property and it prevents initiation and progression of caries by forming a caries resistant complex with inorganic portion of tooth material.[1] The amount of fluoride made available to the oral cavity is not related to the fluoride content of the material, but rather to the ability of the fluoride to leach from the material, or to exchanged for other ions in the oral environment.[2] Glass ionomer cements introduced by Wilson and Kent in 1972 were found to have good adhesion to enamel and dentin and also antibacterial effects due to sustained fluoride release. However, they have limitations as restorative materials due to brittleness, wear and susceptibility to dehydration.[3] RMGIC have been developed to overcome the problems of moisture sensitivity and low initial mechanical strengths typical for GIC. RMGIC are basically formed by adding methacrylate components to the polyacrylic acid, which are polymerizable by light-curing supplementing the fundamental acid-base reaction.

RMGIC have a potential for releasing fluoride in equivalent amounts as conventional cements, but may be affected not only by the formation of complex fluoride compounds and their interaction with polyacrylic acid, but also by the type and amount of resin used for the photochemical polymerization reaction.[4] Few shortcomings in conventional GIC has led to the development of $PMCR_S$ also known as compomers which are easy to handle and are accompanied with improved esthetics, moisture tolerance, good mechanical properties, and durable adhesion to tooth substance. It is reported that the fluoride release of $PMCR_S$ is lower than conventional and RMGIC.[5] The pattern of fluoride release from a $PMCR_S$ is characterized by an initial rapid release followed by rapid reduction in the rate of release after a short period of immersion.[6] The present study is therefore conducted with the purpose of evaluating and comparing the fluoride releasing ability of the conventional glass ionomer cement, resin modified glass ionomer cement and polyacid modified composite.

MATERIALS & METHODS

The study comprised of a total of sixty samples divided in three groups pertaining to three different dental materials used. Group A: Twenty disc shaped samples (8 mm diameter and 2.5 mm thickness) prepared from conventional GIC(Fuji VII); Group B: Twenty disc shaped samples (8 mm diameter and 2.5 mm thickness) prepared from Resin modified GIC (Fuji II LC); Group C: Twenty disc shaped samples (8 mm diameter and 2.5 mm thickness) prepared from Polyacid modified composite (Dyract).

PREPARATION OF ARTIFICIAL SALIVA

The artificial saliva used in this present study was prepared according to Macknight-Hane and Whitford (1992) formula.

The composition of artificial saliva (grams per liter) used in one study contains:

- Methyl-p-hydroxybenzoate 2.00 gm/lt
- Sodium Carboxymethyl Cellulose 10.00 gm/lt
- KCl 0.625 gm/lt
- MgCl2 . 6H2O 0.059 gm/lt
- CaCl2 . 2 H2O 0.166 gm/lt
- K2HPO4 0.804 gm/lt
- KH2PO4 0.326 gm/lt

The pH of artificial saliva was then adjusted to 6.75 by adding potassium hydroxide (KOH).[7]

PREPARATION OF TOTAL IONIC STRENGTH adjusting BUFFERING SOLUTION

TISAB was prepared by dissolving 57ml acetic acid, 45g Sodium Chloride and 4g CDTA (1,2-diamino cyclohexan N,N,N,N-tetra acetic acid) in 500ml distilled water. Adjust pH to 5.5 by adding drops of 5M NaOH, then make up to 1L with water.[8]

PROCEDURE

Each group consist 10 disc of each material were stored in 6 ml deionized water and 6 ml artificial salvia for 7 days at 37 ^{0}C. Each group consist of one control test tube which contain the solution. The amount of fluoride released was measured at predetermined time intervals of 24 hours during the first day and thereafter on 2nd, 3rd, 4th, 5th and 7th day of the study. 1ml tested solution was added by 1 ml TISAB (Total ionic strength adjusting buffering solution). TISAB was used to decomplex contaminating ion and provide a constant background ionic strength.[9] Fluoride release was measured with a fluoride ion specific electrode (Orion Research Inc.) coupled to a microprocessor ion analyser (Model 1901 ,Orion Research Inc.)[3] Calibration of the fluoride electrode was done before each measurement session using fluoride solution containing. 0.1, 1.0 and 10 ppm fluoride.[9] For every time for each measurement the fluoride specific ion electrode was washed out using distilled water & dry with tissue paper to make sure there is no debris or any particles that can alter the reading during measurement.[9]

Fluoride ion specific electrode

STATISTICAL ANALYSIS

All the analysis was done using Statistical Package for Social Sciences (SPSS) version 14. A p –value <0.05 was considered statistically significant. Comparison of fluoride iron release between

Table 1: Comparison of Mean and SD values of fluoride release(in ppm) of Fuji II LC, Fuji VII and Dyract

Restorative material	Day	Medium				p-value
		Saliva		Water		
		Mean	SD	Mean	SD	
Fuji II LC	Day 1	1.00	.05	1.73	.81	0.019; Sig
	Day 2	.59	.10	1.35	.77	0.012; Sig
	Day 3	.23	.10	.38	.28	0.151; NS
	Day 4	.06	.02	.11	.09	0.134; NS
	Day 5	.01	.01	.22	.02	0.002; Sig
	Day 7	.00	.00	.00	.00	-
Fuji VII	Day 1	2.21	.26	3.09	.66	
	Day 2	1.73	.12	2.75	.13	<0.001; Sig
	Day 3	1.08	.10	1.91	.44	<0.001; Sig
	Day 4	.66	.07	1.84	.48	<0.001; Sig
	Day 5	.20	.03	1.73	.49	<0.001; Sig
	Day 7	.09	.01	1.63	.56	<0.001; Sig
Dyract	Day 1	1.07	.05	1.11	.08	0.189; NS
	Day 2	.68	.06	.77	.14	0.062; NS
	Day 3	.21	.02	.61	.10	<0.001; Sig
	Day 4	.07	.01	.43	.13	<0.001; Sig
	Day 5	.02	.01	.20	.10	<0.001; Sig
	Day 7	.00	.00	.00	.00	-

different restorative materials was done using ANOVA with post – hoc Games-Howell test. Comparison of fluoride release in saliva and water was compared using independent sample t test.

RESULT

The comparison of fluoride ion release from three different dental restorations(Fuji VII, Fuji II LC and Dyract) in de-ionized water and artificial saliva for day 1,2,3,4,5 and 7 are shown in Table 1.The result shows significantly different in fluoride ion release from all of them. The fluoride release is highest in Fuji VII, Fuji II LC and Dyract.

DISCUSSION

In this study, deionized water was chosen for the experiment as it provided the baseline of fluoride release potential in unstimulated conditions. Artificial saliva was choosen as a second medium for fluoride leaching so as to simulate to an extent the natural oral environmental conditions.[1] In this study, showed that there were great differences between Fuji VII (conventional glass-ionomer), Fuji II LC (resin modified glass ionomer cement) and Dyract (compomer). This result was in aggrement with previous studies.[10,11] However, study by[10] showed that the cumulative fluoride released in artificial saliva were highest in RMGIC, followed by GIC (Fuji IX, Chem Fil Superior, Ketac-Silver) and compomer (Dyract). From this study, conventional GIC produce a greater fluoride release rather than $RMGIC_S$. Previous study showed that the amounts of fluoride released by $RMGIC_S$ are at least equal to those released by conventional GIC_S [12] and vary between different commercial products. The compomer sets through the polymerization and the acid-base reaction proceeded slowly between carboxyl group and the cations released from the filler. The former mechanism plays a greater part of the setting. The acid-base reaction only occurred in the presence of water. As for the fluoride release from compomer, there are several studies so far.[13] Most of the data reported on the release of fluoride from dental restorations are based upon measurements made in de-ionized water.[14] However, de-ionized water does not represent the true complex chemistry of the oral environment. There is less fluoride released when artificial saliva is used in this study, rather than de-ionized water.[11,15,16] A variety of such fluoride-releasing materials are primarily resin-composite systems with some form of fluoride incorporated into the resin matrix. Most of these materials have a lower level of fluoride release than GICs, and their clinical effectiveness is also unknown.[17] The release of fluoride ions may be modified by the presence of calcium ions in the testing medium, due to the formation of CaF2, as has already been demonstrated by other authors.[18]

CONCLUSION

The following conclusions were drawn from this study.

1) All the materials tested released fluoride in varying concentrations.
2) The fluoride release is highest in GIC, followed by RMGIC and $PMCR_S$.
3) There is greater amount of fluoride release by the tested material in de-ionized water compared with artificial saliva.

REFERENCES

1. Nigam A, Jaiswal JN, Murthy RC, Pandey RK. Estimation of fluoride release from various dental materials in different media. International Journal of Clinical Pediatric Dentistry 2009;2(1):1-8.
2. Hicks J, Goday F, Donly K, Flaitz C. Fluoride releasing restorative materials and secondary caries. Dent clin Am 2002;4(6):246-76.
3. Goyal N, Garg S. Short term fluoride release from some fluoride containing aesthetic dental materials in different media (in vitro). JOCD 2004;7(4):175-81.
4. Weigand A, Buchalla W, Attin T. Review on fluoride releasing restorative materials-Fluoride release and uptake characteristics, antibacterial activity and influence on caries formation. Journal of Dental Material 2007;3(1):343-62.
5. Cildir S, Sandalli N. Fluoride release/uptake of Glass- ionomer cements and Polyacid-modified composite resins. Dental Material Journal 2005;24(1):92-7.
6. Dhull K. Comparative evaluation of fluoride release from PRG-composite and compomer on application of topical fluoride. JOE 2009;27(1):27-32.
7. Rao B, Patri G, Agnihotri Y, Balagopal. Fluoride and Restorative Materials. IJCD 2011;2(3):159-64.
8. Pedrini D, Delbern ACB, Franca JGMand Machado T de M. Fluoride release by restorative materials before and after a topical application of fluoride gel. Pesqui Odontol Bras 2003;17(2):137-41.
9. Yosuff N, Ariffin Z, Hassan A, Alam M. Fluoride release from dental restorations in de-ionized water and artificial saliva. International Medical Journal 2013;20(5):635-8.
10. Yap AU, Khor E, Foo SH. Fluoride release and antibacterial properties of new generation tooth-colored restoration. Oper Dent 1999;24:297-305.
11. El Mallakh BF, Sarkar NK. Fluoride release from glass ionomer cements in de-ionized water and artificial saliva. Dent Mater 1990;,6(2):118-22.
12. Mitra SB. Adhesion to dentin and physical properties of a light-cured glass ionomer liner/base. J Dent Res 1991;70:72-4.
13. Diego S, Daraporn S, Shigeki M, Ika DA. Short-term fluoride and cations release from polyacid-modified composites in a distilled water, and an acidic lactate buffer. Biomaterials 2003;24:1687-96.
14. Mazzaoui SA, Burrow MF, Tyas MJ. Fluoride release from glass ionomer cements and resin composites coated with a dentin adhesive. Dent Mater 2000;16(3):166-71.
15. Levallois B, Fovet Y, Lapeyre L, Gal JY. In vitro fluoride release from restorative materials in water versus artificial saliva medium (SAGF). Dent Mater 1998;14(6):441-7.
16. Sinor Z, Azizah Y, Ismail AR, Normastura AR, Mohd Khairi MD. Salivary parameters and its effect on the occurrence of dental caries. International Medical Journal 2009;16(1):47-52.
17. Gao W, Smales RJ. Fluoride release/uptake of conventional and resin-modified glass ionomers, and compomers. J Dent 2001;29(4):301-6.
18. Adair SM, Whitford GM, McKnight-Hanes C. Effect of artificial saliva and calcium on fluoride output of controlled-release devices. Caries Res 1994;28(1):28-34.