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FLUORIDE RELEASE FROM POLYACID MODIFIED COMPOSITES (COMPOMERS) IN ARTIFICIAL SALIVA AND LACTIC ACID

Liberação de flúor por compósitos poliácidos modificados (compômeros) em saliva artifical e ácido lático

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Abstract

OBJECTIVES: The aim of this study was to assess the effect of different extraction media and time on the amount and pattern of fluoride release from compomers. **MATERIAL AND METHOD**: 42 specimens (n = 7 per group) in disc forms (7 mm diameter, 2 mm thickness) from three different compomers (were placed in artificial saliva (pH = 7.0) and lactic acid (pH = 5.2). The amount of the fluoride in these solutions were measured at 1st, 7th, 14th, 21th and 28th day time intervals by means of the fluoride ion selective electrode.The fluoride amount was calculated by concentration (ppm). The amount and the pattern of fluoride release was dependent on both the material, the storage medium and time. **RESULTS**: Fluoride release was evident for all the compomers but the rate of release varied considerably between the materials. Significant differences were also found between the different types of compomer ($p < 0.01$). A time dependent increase in the fluoride content was observed for all the compomers in both media. For all the tested materials, the fluoride release was higher in the lactic acid ($p < 0.01$).The amount of fluoride release was the most from Compoglass followed by Dyract AP and Glasiosite at 28th days, in both artificial saliva and lactic acid respectively. The least amount of fluoride release was observed at the first day.

Keywords: Fluoride release. Compomers. Artificial saliva. Lactic acid. Restorative materials.

Resumo

***OBJETIVOS**: O objetivo deste estudo foi determinar o efeito de diferentes meios e tempo na quantidade e padrão de liberação de flúor por compômeros. **MATERIAL E MÉTODO**: 42 espécimes (n = 7 por grupo) em discos (7 mm de diâmetro, 2 mm de espessura), três compômeros diferentes, foram colocados em saliva artificial (pH 7,0) e ácido lático (pH 5,2). A quantidade de flúor nas soluções foram medidas a intervalos semanais, do 1º ao 28.º dias (quatro semanas) por meio de eletrodos seletivos para íons flúor. A quantidade de flúor foi calculdada por concentração (ppm). A quantidade e o padrão da liberação de flúor variou consideravelmente tanto do material, do meio de armazenamento e tempo. **RESULTADOS**: A liberação de flúor foi evidente por todos os compômeros, mas a taxa de liberação variou consideravelmente entre os diferentes tipos de compômeros (p < 0.01). Um aumento relacionado com o tempo no conteúdo de flúor foi observado para todos os compômeros em ambos os meios. Para todos os materiais testados, a liberação de flúor foi maior no ácido lático (p < 0.01). A quantidade de liberação de flúor foi maior pelo Compoglass®, seguido pelo Duract AP® e Glasiosite® aos 28 dias, tanto na saliva artificial como no ácido lático respectivamente. A menor liberação de flúor foi observada no primekro dia.*

***Palavras-chave**: Liberação de flúor. Compômeros. Saliva artificial. Ácido lático. Materiais restauradores.*

INTRODUÇÃO

A new restorative material, polyacid-modified composite or compomer, adhere to dentin and enamel, have a stable matrix structure, release fluoride and reduce microleakage. These materials are a composite resin containing a fluoride releasable filler (1-4). The cariostatic activity of fluoride depends mainly on the presence of fluoride in the liquid phase around and in the outer surface layer of a tooth at low pH values. The chemical and physical characteristics of the mouth may influence the properties of restorative materials (5-7).

To determine which material has optimal fluoride release for caries resistance, the relative concentrations and the duration of fluoride release should be examined among these materials.There are many studies for the fluoride release from glass ionomer cements, compomers and composite resins (8-12). These studies showed that the results were affected from the use of different experimental condition, such as manipulation of the material, ratio, mixing, different amount of exposed area for the specimens and nature of the storage medium. Lactic acid and artificial saliva and distilled water were often used for the dissolution media. Many in vitro studies have demonstrated that fluoride is released from compomer within the first day after hardening, falling to a plateau after a few days (13-15).

This in vitro study evaluated the amount and the pattern of fluoride release from three commercial compomers into artificial saliva and lactic acid.

MATERIALS AND METHODS

Compoglass F® (Ivoclar, Vivadent, Münich, Germany), Dyract AP® (Dentsply, De Tery, Konstanz, Germany), Glasiosite® (Voco,Cuxhaven,Germany) were selected for this study. Forty-two specimens (n = 7 per group) were prepared in disc forms (7 mm diameter and 2 mm thickness) according to the manufacturers' instruction.

The artificial saliva and lactic acid were prepared according to Karantakis et al. (9). Each specimen was placed separately in a plastic tubes containing 10 ml artificial saliva and 10 ml lactic acid. All specimens were stored at 37ºC during the time of each measurement.

Before each fluoride concentration measurement, the calibration curve was obtained. Measurements were made at the intervals of 1st, 7th, 14th, 21th, 28th day intervals. Measurements were repeated three times and the concentration values were averaged. Data were analysed by using a calibration curve.

Before each measurement, 5 ml artificial saliva was taken from the plastic tube and then 5 ml fresh artificial saliva was added in this plastic tube. In order to measure the fluoride concentration, 5 ml of the artificial saliva were mixed with 14 ml distilled water and 1 ml TISAB solution (Orion Research Inc., 940911) and fluoride ion-spesific electrode (combination electrode Fluoride 960900; Orion Research Inc.) was used to read the fluoride content of the solution in parts per million (ppm).

To measure fluoride release of compomer materials into the lactic acid protocol were conducted as for artificial saliva.

The data were analyzed by using three-way analysis of variance (ANOVA) and multiple comparison test (DUNCAN).

RESULTS

The mean fluoride release values and standard deviations of each compomer materials are shown in Tables 1 and 2. All the materials evaluated in this study released fluoride during the entire period of the experiment.

TABLE 1 - The mean fluoride release values of each compomers in lactic acid

Materials	1st day	7th day	14th day	21tt day	28th day
Compoglass F	4.7± 0.2 (A)	26.7± 0.6 (A)	58.5± 0.8 (A)	75.1± 0.7 (A)	80.7± 0.8 (A)
Dyract-AP	6.7± 0.3 (A)	28.5± 0.8 (A)	48.7± 1.3 (B)	56.2± 0.7 (B)	58.2± 0.7 (B)
Glasiosite	3.5± 0.3 (A)	8.7± 0.5 (B	12.7± 0.5 (C)	17.7±0.5 (C)	19.7± 0.5 (C)

Difference between mean values that are showed with different letters is statistically significant

TABLE 2 - The mean fluoride release values of each compomer in artificial saliva

Materials	1st day	7th day	14th day	21th day	28th day
Compoglass	6.5± 0.3 (A)	22.7± 0.3 (A)	32.3± 0.5 (A)	41.2± 1.2 (A)	45.2± 0.2 (A)
Dyract-AP	2.7± 0.2 (B)	7.3± 0.3 (B)	12.7± 0.8 (B)	12.8± 0.3 (B)	14.7± 0.3 (B)
Glasiosite	2.2± 0.3 (B	3.5± 0.3 (C)	7.2± 0.3 (C)	10.2± 0.3 (B)	12.2± 0.2 (B)

Difference between mean values that are showed with different letters is statistically significant

Significant differences in fluoride were found among the three different compomers in both artificial saliva and lactic acid ($p < 0.01$). For all the tested materials, fluoride release was significantly higher in lactic acid than in artificial saliva (Figures 1 and 2)

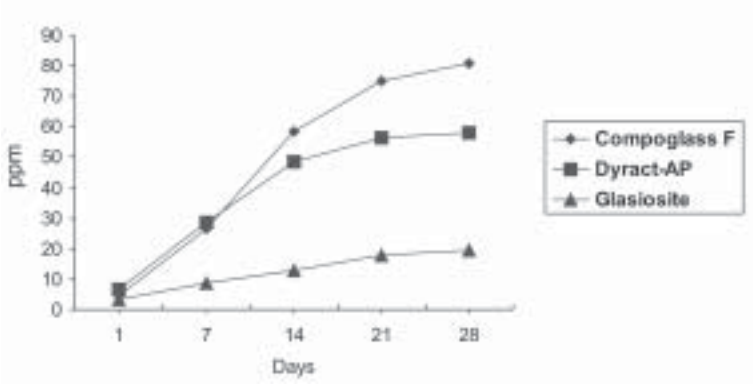

FIGURE 1 - Fluoride release from compomers in lactic acid

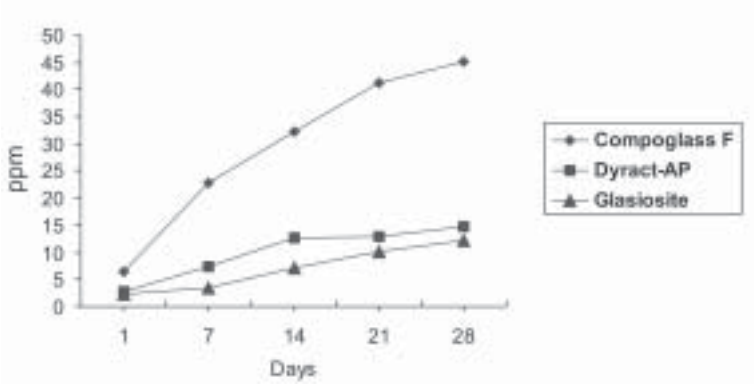

FIGURE 2 -Fluoride release from compomer in artificial saliva

All brands of compomers released increasing amounts of fluoride as a function of time but the rate of release varied considerably among the materials. The amount of fluoride release was the most from Compoglass® (80.7- 45.2 ppm) followed by Dyract-AP® (58.2 - 14.7 ppm) and Glasiosite® (19.7 - 12.2 ppm) at the end of 28 days, in both lactic acid and artificial saliva, respectively. The least amount of fluoride release was observed at the first day ranging between 3.5 - 6.7 ppm in lactic acid and 2.2 - 6.5 ppm in artificial saliva. The least fluoride release was found with Glasiosite® in artificial saliva. The pattern of fluoride release was similar in all media.

DISCUSSION

Several investigations have been performed on fluoride release from various dental restorative materials including resin composites, glass-ionomer cements and compomers (8-11). The setting mechanism of the compomers was entirely a free-radical polymerization that was proposed to be a relatively slow reaction. Once the monomer of compomers were polymerized and exposed to saliva, the acid groups caused the resin to take up the moisture thereby activating the acid-base reaction between the acidic functional groups and the basic glass filler. In these studies, fluoride release was evaluated using various experimental designs and storage media. It is generally accepted that fluoride, aluminum and strontium ions are released with diffusion process without deterioration of physical properties of the material. They were released much more in the lactate buffer (pH 4.1) than in distilled water.

The pattern of fluoride release from the materials was similar, peaking with in the first few days after being placed in the storage solutions. The pH of the environment affected the fluoride release differently among the materials (11, 13, 15-21).

All the compomer materials evaluated in our study demonstrated low fluoride release initially at the first day but the amount increased at 7th and 14th days. The fluoride release then proceeded with a slow increase at 21th and 28th days of observation periods. The rate of the release remained relatively constant after 21th day. These result explained that the acid groups of the resin to take up moisture slowly.

Even though all the materials tested demonstrated similar dissolution patterns during our examination period, the amount of fluoride release from the different compomers varied from one another at various time intervals. This depends not only on the concentration of fluoride but on whether it can diffuse out from within the material. The authors observed that the fluoridated resin composites released fluoride in small amounts, approximately 10 times less than compomers during the first day (15).

In order to understand the differences between the materials, it is important to note that they all contain fluoride in their glass filler particles. The difference between the fluoride release mechanism in glass-ionomer cements and compomers at short immersion periods may be due to loose bonding property of fluoride in compomers. Therefore, after polymerization a less amount of fluoride containing glass fillers will be exposed to the storage medium. It was also

observed in this study that fluoride release from the compomer were dependent on the storage medium as statistically significant differences were observed in the fluoride release amount between artificial saliva and lactic acid.

Polyacid-modified resin composites presented a lower rate of fluoride release compared to resin modified and conventional glass ionomer cements in previous studies (15, 20). Published data shows a higher release in an acidic environment compared to a neutral environment (21-25).

The results of this study demonstrated that the released of the fluoride from compomers were influenced by pH variation.

CONCLUSIONS

The variation in pH influenced fluoride release of the materials. The pattern of fluoride release was similar in the three different compomers at both artificial saliva and lactic acid.

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