EFFECT OF ARTIFICIAL SALIVA ON THE SURFACE ROUGHNESS OF GLASS-IONOMER CEMENTS

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ABSTRACT

The glass ionomer cements are used clinically in different areas of restorative dentistry. The life span of dental restorations depends on the properties of the material such as durability, wear resistance and type of damage to the tooth. The purpose of this study is to evaluate the effect of arficial saliva with different pH on the surface roughness of three types of glass ionomer

Keywords: glass ionomer cement, restoration, artificial saliva, pH, roughness

1. Introduction

Dental restorative materials used include biomaterials such as resin composites (RC), glass-ionomer cements (GICs) and resin-modified glass-ionomer cements (RMGIC). Restorative materials generally used in daily clinical practice, such as glass-ionomer cements, composite resins can be used for re-establishing tooth structure, function and aesthetic, as well as for controlling hypersensitivity.

One factor which influences the clinical performance of dental restorations is their resistance to damage. In the oral cavity, this process includes sliding, abrasion, chemical degradation and fatigue [1]. These mechanisms can act alone or in combination. Considering the intricacy of the oral enviroment, the breakdown of dental materials mediated by biological activity is very complex [2].

However, it has been suggested that the oral enviremenent is likely to cause more pronounced filler degradation than indicated by storage in distilled water [3]. Little is known of the chemical changes associated with the surface roughness changes in various media such as artificial saliva.

The purpose of this study is to evaluate the effect of arficial saliva with different pH on the surface roughness of three types of glass ionomer cements.

2. Materials and methods

The factors under study are three types of glass ionomer cements and artificial saliva at three different pHs. The association between GICs and storage media resulted in four groups.

The glass ionomer cements used in this study are given in Table 1.

Table 1. Restorative materials used in study

Brand, Manufacturer	Manufacturer
Ketac Molar, ESPE	Conventional glass ionomer cement filling (GIC)
Dyract, Dentspy	Polyacid-modified composite resin (PAMRC)
Vitremer, 3M Dental	Resin modified glass ionomer cement (RMGIC)

Specimen preparation

Three direct restorative materials, including one conventional glass ionomer cement, one resin modified glass ionomer and one polyacid-modified composite resin were evaluated in this study. For each material, 20 specimens (10 mm diameter x 2 mm thickness) were randomly made.

Restorative materials were handled according to each manufacturers instructions.

Artificial saliva

The artificial saliva (SAL) was of the following composition: NaCl, 0,400g; KCl 0,400g; $CaCl_2H_2O$, 0,795g; NaH_2PO_4 0,69g; Na_2Sx9H_20 0,005g; urea 1,0g; distilled water 1000ml. The pH was then adjusted to 3, 7, or 9 with NaOH or HCl, and the volume made up to 1L.

Storage protocols

The specimens were weighed and submerged by pouring 50±1ml of distilled water and artificial saliva (pH 3, 7, or 9), and stored at 37±1°C for 24 hours, 48 hours, 72 hours, 7 days, 14 days and 28 days.

At the end of each time period, specimens were removed from the saliva, blotted with clean absorbent paper, and stored in a desicator until constant weight was attained. Amount of weight loss was calculated as the difference between the initial weight of the specimen and its final constant weight

after storage in the desicator. Percentage of solubility was calculated as 100 per cent times weight loss divided by the initial weight of the specimen.

Surface roughness measurements

The specimens were subjected to final reading of surface roughness. The measurement procedure was similar to that for the baseline condition. The analysis surface roughness was quantitatively carried out by means of a surface roughness measuring instrument (A Perthograph R100). Surface roughness was characterized by the height parameter, Ra (µm), defines as the arithmetical average of the absolute values of profile departures in relation to length. The measurement procedure were repeated for 1, 7, 14, 28 days.

Statistical analysis

The results were analyzed by means of one-way ANOVA and Tukey's test.
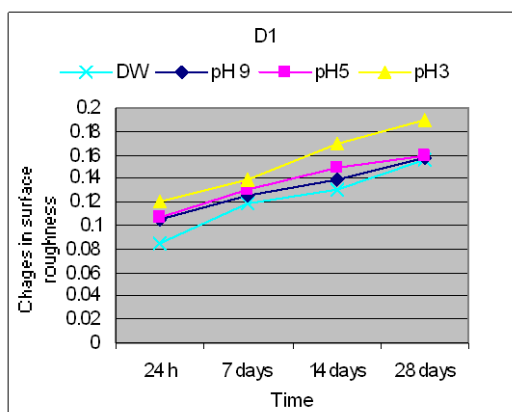
3. Results

A study of the interaction among the factors analyzed (restorative materials and storage media) was made.

Table 2 presented the adjusted mean values (standard error) of the percentage of weight loss (%) of each one of the three groups.

Table 2. Averages and standard deviations for percentage of weight loss

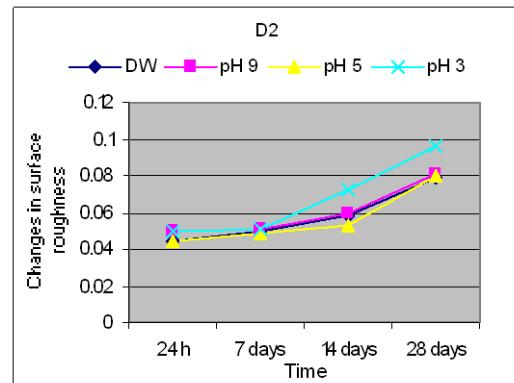| Material	Mean weight loss (%)	Standard deviation
Ketac Molar	1.4837	0.3895
Dyract	2.0813	1.0086
Vitremer	1.158	0.1299

Graph 1. Changes in surface roughness of Ketac-Molar over 28 days

The surfaces micro morphology examination showed that all the materials have increasing trends of surface roughness as the immersion time increased. No significant difference in surface roughness existed between distilled deionizer water and artificial saliva with pH 5 or 9 (Table 2).
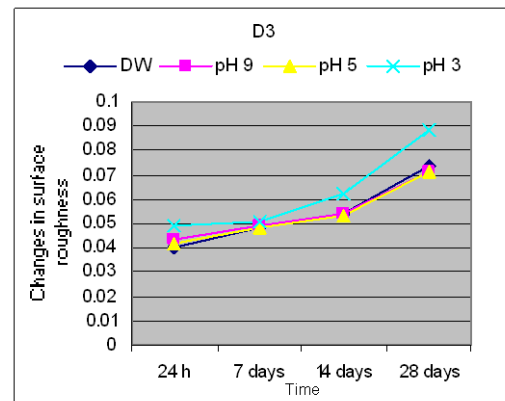
In the period 1 – 14 days the surface roughness of all materials increased with no significant difference between groups.

Dyract and Vitremer – the Ra values in all groups had increased in 14-28 days time interval (graph 2, graph 3).

At 28 days, Ketac Molar was found to have suffered the greatest increase in surface roughness, after immersion in artificial saliva with pH3. No significant difference was found between pH9 and pH5 (graph 3).

Graph 2. Changes in surface roughness of Dyract over 28 days

Graph 3. Changes in surface roughness of Vitremer over 28 days

The roughness average increased when specimens were immersed a log time in acid artificial saliva (pH 3).
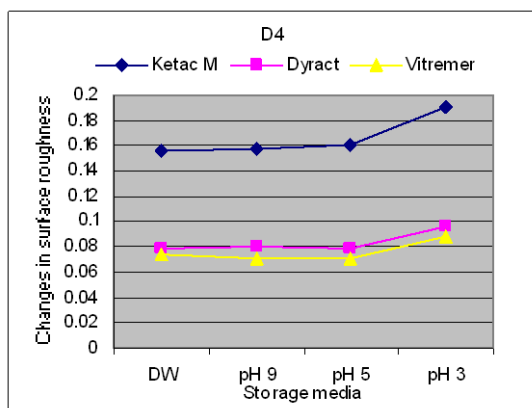
4. Discussion

In attempting to understand the phenomena involved in the biodegradation of resin-based restorative materials, *in vitro* (Chadwick et al., 1990;

de Gee et al., 1996; Cattani-Lorente et al., 1999), *in situ* (Roulet et Walti, 1984) and *in vivo* (Sidhu, Sherriff and Watson, 1996) experiments have been carried out. In spite of the mounth being the ultimate testing environment for predicting the behavior of restorations, because of the complexity and diversity

of intra-oral conditions, *in vitro* models may be most important in providing an insight into the fundamental mechanism of biodegradation.

Table 3. Results of Tukey's test for Ra (µm)

Medium/material	Ketac Molar	Dyract	Vitremer
Distilled water	0.1561	0.0788	0.0740
Arficial saliva pH 9	0.1573	0.0811	0.0712
Articial saliva pH 5	0.1601	0.0795	0.0714
Artificial saliva pH 3	0.1899	0.0963	0.0889

Graph 4. Changes in surface roughness over 28 days

The degradability of restorative materials by chemicals has been evaluated by various methods such as micro hardness (van Groeningen et al., 1986; Chadwick et al., 1990), surface roughness (Roulet and Walti, 1984), profile tracings (de Gee et al., 1996), weight change (Lavis et al, 1997), leaching of filler elements (Soderholm et al., 1996), scanning electron microscopy (Gao et al., 1997) and polarized light microscopy (Wu et al., 1984).

In the present study, surface roughness assessment was chosen because it is well documented that surface micro morphology can play a role in bacterial colonization and in maturation of plaque on restorative materials. Although the effect of surface properties on these phenomena have been reported as contradictory (Steinberg et al., 1999), the interactions may predispose a restoration to the development of secondary caries and may lead to periodontal inflammation.

5. Conclusions

Under the conditions this study was carried out, it may be concluded that:

1. All the materials have increasing trends of surface roughness as the immersion time increased.

2. That restorative materials are influenced by the storage media, presenting significance alteration in acid storage (in the present study, the storage was in artificial saliva of different pHs).

3. Conventional glass ionomer cement is less resistant to abrasion, compared with resin composite, but GICs resistance increases in time.

4. As long as the material is being tolerated and protected by the dental structure, its resistance to abrasion will be satisfactory.

Alterations in the surfaces topography and changes in wear rate, can not fully predict the clinical behaviour of restorative dental materials.

6. References

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