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Rinsing with antacid suspension reduces hydrochloric acid-induced erosion

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ABSTRACT

Objective: Mouthrinsing with antacids, following erosive episodes, have been suggested as a preventative strategy to minimize tooth surface loss due to their neutralizing effect. The purpose of this *in situ* study was to evaluate the effect of an antacid suspension containing sodium alginate, sodium bicarbonate and calcium carbonate in controlling simulated erosion of enamel of intrinsic origin.
Design: The experimental units were 48 slabs ($3 \times 3 \times 2$ mm) of bovine enamel, randomly divided among 12 volunteers who wore palatal appliances with two enamel slabs. One of them was exposed extra-orally twice a day to 25 mL of a hydrochloric acid (HCl) solution (0.01 M, pH 2) for 2 min. There were two independent phases, lasting 5 days each. In the first phase, according to a random scheme, half of the participants rinsed with 10 mL of antacid suspension (Gaviscon®, Reckitt Benckiser Healthcare Ltd.), while the remainder was rinsed with deionized water, for 1 min. For the second phase, new slabs were inserted and participants switched to the treatment not received in the first stage. Therefore, the groups were as follows: (a) erosive challenge with HCl + antacid suspension; (b) erosive challenge with HCl + deionized water (DIW); (c) no erosive challenge + antacid suspension; (d) no erosive challenge + DIW. Specimens were assessed in terms of surface loss using optical profilometry and Knoop microhardness. The data were analyzed using repeated measures two-way analysis of variance and Tukey's tests.
Results: Compared to DIW rinses, surface loss of enamel was significantly lower when using an antacid rinse following erosive challenges ($p = 0.015$). The Knoop microhardness of the enamel was significantly higher when the antacid rinse was used ($p = 0.026$).
Conclusions: The antacid suspension containing sodium alginate, sodium bicarbonate and calcium carbonate, rinsed after erosive challenges of intrinsic origin, reduced enamel surface loss.

1. Introduction

As dental wear is a prevalent condition among all age groups (Corica & Caprioglio, 2014; Jaeggi & Lussi, 2014; Schlueter & Tveit, 2014; Alvarez Loureiro, Fabruccini Fager, Alves, Alvarez Vaz, & Maltz, 2015; Kitasako, Sasaki, Takagaki, Sadr, & Tagami, 2015; Salas, Nascimento, Huysmans, & Demarco, 2015), there is growing focus in understanding the physiopathology and interest in controlling dental wear, with particular emphasis being devoted to erosive tissue loss.

Dental erosion is caused by nonbacterial acids undersaturated with respect to both hydroxyapatite and fluorapatite (Larsen, 1975; Meurman & ten Cate, 1996) which dissolve apatite crystals. The erosive acids may be of intrinsic or extrinsic origin (Ganss, Lussi, & Schlueter, 2012). The former include beverages and foodstuffs, while intrinsic causes refers to the presence of hydrochloric acid from the gastric juices, which reaches the oral cavity through vomiting or by regurgitation (Li, Zou, & Ding, 2012; Mulic, Skudutyte-Rysstad, Tveit, & Skaare, 2012; Hermont et al., 2014; Moazzez & Bartlett, 2014).

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Amongst the approaches proposed to control erosive tissue loss due to intrinsic acids is the use of neutralizing agents (Meurman, Kuittinen, Kangas, & Tuisku, 1988; Messias, Turssi, Hara, & Serra, 2010; Lindquist, Lingström, Fändriks, & Birkhed, 2011; Turssi et al., 2012). In fact, rinsing with sodium bicarbonate solution rightly after a simulated endogenous erosion has demonstrated efficacy in minimizing enamel loss (Messias et al., 2010). In addition, it has been shown that antacid commercial preparations can provide quicker salivary recovery when used as a mouthrinse, after an erosive challenge (Meurman et al., 1988; Lindquist et al., 2011). Antacid suspensions composed of aluminum hydroxide, magnesium hydroxide, hydrated magnesium aluminate, sodium alginate, sodium bicarbonate and/or calcium carbonate afforded a significant reduction in enamel wear (Turssi et al., 2012). However it is not known if this benefit would persist when these suspensions are used clinically, in the form of mouthrinse.

Given the knowledge that a suspension containing sodium alginate, sodium bicarbonate and calcium carbonate has an effect over the control of erosion (Turssi et al., 2012) and that in the saliva sodium alginate forms a solution of high viscosity (Buts, Barudi, & Otte, 1987), with the capacity to neutralize acids (Tytgat & Simoneau, 2006), it was deemed appropriate to perform a study which would analyze the ability of such an antacid suspension, to control the effects of erosive episodes of intrinsic origin, provided that it simulates the intra-oral environment and that, at the same time, it makes it viable to obtain accurate measurements of the potential benefits that could ensue.

The aim of this *in situ* study, therefore, was to investigate the effect of an antacid suspension to control surface loss of enamel, after simulation of erosive challenges of intrinsic origin. Additionally, it was analyzed the surface microhardness of enamel. The null hypothesis tested were that there would be no significant difference in surface loss and microhardness of enamel whether antacid suspension rinses were performed after erosive challenges.

2. Materials and methods

2.1. Experimental design

This study was conducted in accordance with a 2 × 2 crossover trial in which the independent variables were *Rinse* at two levels [(antacid suspension containing sodium alginate, sodium bicarbonate and calcium carbonate, Gaviscon® (East Yorkshire, UK: Reckitt Benckiser Healthcare Ltd.) or deionized water)] and *Erosive Challenge* at two levels [present (solution of hydrochloric acid) or absent]. The experimental units consisted of 48 slabs of bovine enamel, divided at random among 12 volunteers.

In the experimental stage, there were two independent phases, each lasting 5 days. In the first leg, set according to a random draw, half of the participants in the study rinsed with the antacid suspension while the other volunteers rinsed with deionized water. In the second leg, the participants switched to the treatment not received in the first phase. At the end, each experimental group comprised 12 slabs of bovine enamel, in accordance with the following treatments: (a) erosive challenges with hydrochloric acid + rinses with antacid suspension ($n = 12$); (b) erosive challenges with hydrochloric acid + rinses with deionized water ($n = 12$); (c) no erosive challenges + rinses with antacid suspension ($n = 12$); (d) no erosive challenges + rinses with deionized water ($n = 12$).

The dependent variables were surface loss (measured in μm) and Knoop surface microhardness (in kg/mm^2).

2.2. Volunteers

Ethical approval for the study was granted by the Research Ethics Committee at São Leopoldo Mandic Dental School (protocol no. 2012/0408). A total of 12 panelists (5 males and 7 females) ranging from 18 to 38 years of age volunteered for this study.

The criteria used for participant inclusion were as follows: good overall health, check for normal salivary flow (>0.7 mL/min), absence of active caries lesion, absence of non-carious lesions or exposed root surfaces, no periodontal disease nor any fixed or removable prostheses or orthodontic devices. Individuals undergoing medical treatment were also ineligible as were those with digestive disorders (gastroesophageal reflux disease, gastritis) and users of medication that causes reduced saliva flow. Pregnant women and finally were also ineligible.

Panelists who expressed an interest in participating in this study were seen by the principal investigator to have their medical history recorded, an oral soft tissue examination and inclusion/exclusion criteria checked. Once deemed suitable, potential volunteers were verbally informed about the study aim and procedures, and gave written informed consent.

2.3. Preparation of the enamel samples

Fourteen bovine incisors, stored in 0.1% aqueous thymol solution, with no coronal cracks or enamel malformations were used in this study. The teeth were scraped clean of any remaining soft tissue with a scalpel, polished with pumice slurry, and sectioned at the cemento-enamel junction, using a low-speed water-cooled diamond saw (Isomet 1000, Buehler Ltd., Lake Bluff, IL, USA). Each tooth was cut mesiodistally and buccolingually to obtain four enamel slabs measuring 3 × 3 × 2 mm. Sectioned pieces were mounted on acrylic rods with sticky wax and ground/polished using a Ecomet 250 grinder-polisher (Buehler Ltd., Lake Bluff, IL, USA) coupled with a Buehler Automet 250 head (Buehler Ltd., Lake Bluff, IL, USA). Slabs were wet flattened with aluminum oxide abrasive papers (600- and 1200-grit) and polished with a 0.3-μm alumina suspension (Alfa Micropolish, Buehler Ltd., Lake Bluff, IL, USA). Slabs were ultrasonicated in deionised water for 10 min to remove any residues of the polishing procedure. Each slab was then masked with unplasticised polyvinyl chloride (UPVC) tape (Graphic Tape; Chartpak, Leeds, USA) on either side of a 1-mm wide window of enamel.

2.4. Sterilization and selection of specimens

The samples were sterilized using ethylene oxide and were then analyzed using an optical profilometer (Proscan 2000, Scantron, Venture Way, Taunton, UK) to check for flatness using dedicated software (Proscan Application software version 2.0.17).

Slabs were also pre-tested using a HVS-1000 microhardness tester (Panambra Zwick Com. Máq. Equip. Ltda, São Paulo, SP, Brazil). Five Knoop microhardness indents (50 g, 15 s) were made 100 μm to the left of center on the surface of each sample, spaced 200 μm apart.

Slabs were then randomly allocated into four groups ($n = 12$) to be subjected to: (a) erosive challenges with hydrochloric acid + rinses with antacid suspension; (b) erosive challenges with hydrochloric acid + rinses with deionized water; (c) no erosive challenges + rinses with antacid suspension; (d) no erosive challenges + rinses with deionized water.

2.5. Preparation of the palatal *in situ* devices

Maxillary and mandibular alginate impressions (Jeltrate/Dentsply, Petrópolis, RJ, Brazil) were recorded in a perforated