

# Efficacy of a Commercially Available Hydroxyapatite-containing Toothpaste in Reducing Dentin Hypersensitivity

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**Objective:** The aim of this study was to evaluate the efficacy of a desensitizing toothpaste in the reduction of dentin hypersensitivity in a randomized, double-blind, cross-over, controlled clinical trial.

**Methods:** Twenty patients who presented some degree of sensitivity to air stimulation were treated with desensitizing toothpaste containing hydroxyapatite (A) or a placebo (B).

**Results:** The paired t-test showed that treatment with A was capable of reducing sensitivity scores. The Wilcoxon test ( $\alpha = 0.05$ ) revealed significant differences between A and B.

**Conclusion:** It may be concluded that treatment with A effectively reduced dentin hypersensitivity. The effect was instant and long lasting.

**Keywords:** toothpaste, dentin hypersensitivity, hydroxyapatite

## Introduction

Dentin hypersensitivity can be defined as a temporary pain or exaggerated response following exposure of the dentin to chemical, tactile, thermal or osmotic stimuli in the buccal environment (1). Under normal conditions, dentin is covered by enamel or cement and is not directly exposed to the buccal environment (2). However, the enamel integrity may be disrupted by abrasion, erosion, abfraction or root surface exposure caused by gingival recession, periodontal treatment or a combination of both. These factors may expose the dentin tubules, resulting in dentin sensitivity (3,4). In a study that was conducted in Indonesia, 65% of Indonesians experienced dentin hypersensitivity. Fifty-two percent of those who had sensitive teeth were

females. The highest incidence was documented in the 25- to 40-year-old age group.

Hydroxyapatite ( $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ ) is major component and an essential ingredient of normal bone and teeth; this compound is responsible for the rigidity of bones and teeth. It is one of a few materials that are classified as bioactive, meaning that it has the ability to integrate in tooth or bone structures and support ingrowth without breaking down or dissolving (5). It acts not only by obliterating the dentin tubules and by precipitating on the surface and inside the dentin tubules but also by the depolarization of nerve endings. This mechanism explains why desensitizing toothpastes usually act over both the short and the long term (6,7). Potassium citrate solutions have been tested *in vitro* (8) and *in vivo* (9) and have shown promising results in treating dentin hypersensitivity. The aim of this study was to evaluate the efficacy of a desensitizing toothpaste in the reduction of dentin hypersensitivity in a randomized, double-blind, cross-over, controlled clinical trial and to test the hypothesis that hydroxyapatite has an instant and prolonged effect in reducing dentin hypersensitivity.

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Received November, 15, 2011, Revised January, 18, 2012, Accepted September, 25, 2012

## Material and Methods

Caries-free patients who had at least 2 teeth with clinical diagnoses of moderate or severe dentin hypersensitivity, adequate oral hygiene, and no periodontal disease or parafunctional habits were considered to be eligible for this study. The clinical diagnosis was performed using a uniform source of light, which was provided by a conventional operating dental light system, a mouth mirror, and the air-blast technique in association with use of the Schiff Air Sensitivity Technique Score. The Schiff indexes were 0 for subjects who did not respond to stimuli; 1 for subjects who responded but did not ask for cessation of the stimulus; 2 for subjects who responded and avoided the stimulus; 3 for subjects who responded and asked for cessation of the stimuli. The teeth selected had Schiff scores of 2 or 3 and displayed no caries, cracks or fractures, extensive or unsatisfactory restorations, recent restorations involving the buccal surface, prostheses or orthodontic appliances. The patient's general health was assessed by interview. Those who presented severe systemic and/or psychological diseases, the constant use of analgesics and/or anti-inflammatory drugs or an allergic response to dental products were excluded from the study.

The power of paired-sample t-test was calculated to be 80% for a sample size of 20, the default significance level (alpha level) was set at 0.05, and the alternative was 2-sided. The sample included 20 healthy patients (6 males and 40 females) with a mean age of 31 years who had at least 2 teeth with dentin hypersensitivity, met all other inclusion criteria and did not meet any of the exclusion criteria. Participants were informed of the pur-

pose and design of the investigation and signed an appropriate informed consent form. The research protocol was approved by the Ethics Committee in Research at the Faculty of Dentistry University of Indonesia.

Each tooth was tested using the Electric Pulp Test (EPT). The degree of hypersensitivity was graded according to the Visual Analog Scale (VAS) from 0 to 10, in which: 0=no discomfort, 1-4=minimum discomfort, 5-6=mild discomfort and 7-10=intense discomfort (10). The values were always collected before, after 30 seconds and after 8 hours of treatment. Treatment results were normalized for a given patient to permit data correlation regarding his/her sensitivity threshold. The desensitizing toothpaste and placebo were applied by one experienced operator, other than the examiner, as follows: 1) water rinse; dentin prophylaxis to remove gross plaque accumulation; 2) cotton isolation rolls; 3) dentin drying with an air syringe; 4) application of each substance by rubbing the material on the teeth for 30 seconds; and 5) removal of the excess using cotton pellets. Placebo control is defined as a formulation containing no ingredients expected to have or proven to be of therapeutic value in treating dentin hypersensitivity (12). The patients were instructed to avoid using any other desensitizing agent during the course of the investigation. Toothpaste efficacy was tested after each session using the VAS and EPT to record the degree of dentin sensitivity after 30 seconds and 8 hours after the application. The sensitivity patterns were recorded by an examiner who had previously calibrated stimulus application. Both the examiner and the patients were blinded to the type of treatment applied to each tooth. The intra-examiner weighted kappa value was calculated using the baseline values for hypersensitivity, after reexamining 20% of the patients that could be enrolled in the study and was determined to be 0.87. This value was not reassessed after the treatment had ended because at that time, changes in hypersensitivity scores may have been due to treatment and not to intra-examiner agreement. To verify the efficacy of the treatments in reducing sensitivity, the numerical scores were analyzed before treatment as well as after 30 seconds and 8 hours of each treatment using a paired t test. The Wilcoxon test was used to compare the treatments. The significance level was set at 5% (Table 1).

**Table 1.** Groups, materials and composition

Group	Composition of active materials for dentin hypersensitivity
A	Potassium Citrate, Hydroxyapatite, Zinc Citrate, Sodium Monofluorophosphate, Sodium Hydroxide, Tocopheryl Acetat, PEG-32, C1 73360, Cl 77891, Mica, Cellulose Gum, Flavor, Trisodium Phosphate, Sodium Saccharin, Sodium Lauryl Sulfate, Hydrated Silica, Sorbitol, Water
B	Containing no ingredients expected to have or proven to be of therapeutic value in dentin hypersensitivity

**Table 2.** The sensitive scores by EPT

Groups	Baseline (1)	After 30 seconds (2)	After 8 hours (3)	Significance between (1) & (2)	Significance between (1) & (3)	Significance between (2) & (3)
A	3.4	5.9	4.6	p<0.05	p<0.05	p<0.05
B	4.1	4.9	4.1	NS	NS	NS
Significance between A & B	NS	p<0.05	NS			

p-values obtained with paired t-test (p<0.05). NS: not significant.

**Table 3.** The sensitive scores by VAS

Groups	Baseline (1)	After 30 seconds (2)	After 8 hours (3)	Significance between (1) & (2)	Significance between (1) & (3)	Significance between (2) & (3)
A	4.9	3.5	3.7	p<0.05	p<0.05	NS
B	4.8	4.3	4.7	NS	NS	NS
Significance between A & B	NS	p<0.05	p<0.05			

p-values obtained with paired t-test ( $p < 0.05$ ). NS: not significant.

## Results

The paired t test showed that treatment with A was capable of reducing sensitivity scores for both stimuli (Table 2). According to the Wilcoxon test, sensitivity scores were significantly decreased ( $p < 0.05$ ) for A and B in comparison to the scores obtained for the placebo, when the EPT and VAS were applied. The EPT and VAS scores differed significantly before and after treatment with A ( $p < 0.05$ ) (Table 3).

## Discussion

This clinical evaluation compared the tooth response 30 seconds and 8 hours after the application of two toothpastes with the use of a placebo as a control. In the present study, all the formulations investigated reduced dentin hypersensitivity. The main component in the A formulation is hydroxyapatite. Laboratory tests of desensitizing toothpaste are conducted to evaluate their effectiveness and to predict their clinical performance. Laboratory studies, however, do not reflect the clinical behavior of the material or technique, and clinical evaluations are necessary to confirm the efficiency of a product (3,10,11,13). In the present study, the desensitizing toothpastes were applied for 30 seconds, which was sufficient for crystal precipitation. The A formulation may occlude the dentin tubules through the deposition of calcium phosphate. Mineralized substances are deposited in and over the dentin tubules, which results in the rapid precipitation of amorphous calcium phosphate, which in turn is rapidly converted to apatite. Several treatment modalities and toothpastes have been used in the management and resolution of dentin hypersensitivity, but their efficacy has varied from one study to another (14-17). The present study suggests that knowledge of the factors involved in dentin hypersensitivity is necessary for effective treatment with commercially available desensitizing toothpaste (18). Dentin hypersensitivity was effectively reduced through the use of toothpaste A. This effect is rapid and long lasting (19).

## Acknowledgement

This research was supported by Unilever, Nursasongko B, Mutiara A, Sari IP, Putri K whom the authors gratefully acknowledge.

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