

## The Effect of Mouthwashes on Surface Hardness of Dental Ceramics

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### Abstract

**Statement of problem:** The effect of different mouthrinses on the surface characteristics of ceramic materials is not documented.

**Objectives:** The aim of this study was to determine the effect of three mouthrinses, containing either alcohol, hydrogen peroxide or fluoride, on microhardness of two dental ceramics, (Duceram love, IPS e.max Ceram).

**Materials and Methods:** Eighty cylindrical disks were prepared and divided into eight experimental groups (n=10 for each group) according to the ceramic material and storage solutions. The microhardness of each sample in all groups was recorded prior to testing. For each ceramic, three groups were immersed in one of the three mouthrinses for a total of 24 and 96 hours. The fourth group was immersed in distilled water as the control. At the end the specimens were taken out, rinsed, dried and tested using microhardness tester.

**Results:** The results of the two-way ANOVA indicated that there was no interaction between media, time and materials ( $P>0.05$ ). Microhardness of the ceramics was not adversely affected by immersion in the studied mouthrinses.

**Conclusions:** The patients with porcelain restorations should be assured that using mouthrinses containing hydrogen peroxide, alcohol or fluoride do not damage the surface hardness of the porcelain.

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### Introduction

Fixed restorations have become an integral part of prosthodontic treatment. Porcelain is used extensively in fixed restorations due to its natural appearance. It fulfills the aesthetic and functional demands of the patients by its superior properties than other restorative materials like metals, acrylic and composites [1].

Caries control is necessary for the long-term success of restorations. Patients with porcelain restorations may hence be treated with fluoride contained solutions to prevent recurrent or secondary caries along with restorations and prepared tooth

junction. Fluoride is routinely prescribed for children, adults and for those who had previously been treated by radiation therapy to the head and neck [2]. The highly glazed surfaces of porcelain restorations can be etched and roughened by repeated application of fluoride solution or gels [3].

Due to aesthetic demands and a desire to have a beautiful smile, patients request bleaching treatment frequently. Tooth bleaching materials containing hydrogen peroxide have been reported in the literature as an aesthetic treatment option as early as 1900s. Hydrogen peroxide is very unstable, and dissociates immediately in contact with tissues or saliva [4]. Since

the whitening agents are basically acidic in nature their effect on the surface properties of aesthetic dental restorative materials is controversial [5].

Reports have stated that the alcohol in mouthrinses may soften the resin-composite restorations [6]. However, both alcohol-containing and alcohol-free mouthrinses could affect the hardness of restorative materials [6-7]. The hardness is related to materials' strength, rigidity, and their ability to be abraded by opposing dental structures or materials. Hence if any chemical softening material is produced from any procedure, the clinical durability of the restorations would be jeopardized [8,9].

Although the effect of mouthrinses on restorative materials are different depending on many factors that could not be replicated in-vitro, routine in-vitro testing of aesthetic restoratives is recommended for products that can be used by patients and/or by dentists.

The effect of different mouthrinses on the surface characteristic of dental porcelains is lacking. Hence this in-vitro study aimed to examine the effect of mouthrinses containing fluoride, hydrogen peroxide or alcohol on the microhardness of two dental porcelains.

## Materials and Methods

One conventional feldspathic porcelain material (Duceram love, Degu Dent GmbH, Denstply, Germany) and one flourapatite containing ceramic (IPS e.max ceram, Ivoclar- Vivadent AG, Germany) were selected for this study. Forty disc specimens (10 mm diameter, 2 mm thickness) were produced from each ceramic according to the manufacturer's instructions. The mixture of powder/liquid was condensed into the silicone mold. Excess liquid on the surface of the specimen was blot dried with a piece of absorbent paper. After condensation, the specimens were removed from the molds and cured in the chamber of the furnace. Subsequently, the specimens were polished (model Phoenix 4000; Buehler GmbH, Dusseldorf, Germany) under running water on a rotating disc at 150 rev/min using 600- and 1200-grit silicon carbide paper (3M ESPE, St. Paul, MN). Then, the specimens were ultrasonically cleaned in distilled water for 10 min and processed for self-glazing according to the manufacturer's instructions.

Forty discs from each material were divided into four groups (10 discs per group). In order to obtain baseline values, all discs were subjected to microhardness testing before immersion. Treatment groups were immersed in either hydrogen peroxide, fluoride or alcohol containing mouthrinses and the control group was stored in distilled water. The mouthrinses' brand name, composition and manufacturer are represented in Table 1.

Each experimental group was stored in 20 ml of one of the mouthrinses for a total of 24 and 96 hours which is equivalent to 2 and 8 year of 2 min daily use respectively [10]. Vickers Microhardness measurements were obtained using a microhardness tester (Micromet II, Buehler Ltd., LakBluff, IL, USA) under 500grams indentation load for 30 seconds. Five indentations per specimen were performed on the surface and the mean hardness value was calculated.

Data were analyzed using SPSS version 16.00 by two-way analysis of variance and a Tukey HSD post-hoc test for group's comparison ( $\alpha=0.05$ ).

## Results

The Vickers microhardness values of the two types of ceramic before and after immersion are reported in Table 2.

The results of the two-way ANOVA and post-hoc test showed no statistically significant differences between the two types of ceramics, different mouthrinses and the interaction between the two. No statistically significant differences were found in microhardness values ( $P>0.05$ ) between the groups before or after immersion.

In comparison with the baseline, after 96 hours immersion in mouthrinses, microhardness values of all groups decreased slightly but not significantly difference.

## Discussion

According to the results of this study, different mouthrinses did not affect the hardness of the porcelains.

The longevity and durability of the aesthetic restorative materials in the oral environment are important factors for the proper selection of the

**Table 1:** The mouthrinses' brand name, composition and manufacturer

Mouthrinses	Composition	Manufacturer
Listerine	Eucaptol, methyl salicylate, mentho, thymol water, alcohol	Johnson and Johnson healthcare products, USA
Oral-B sensitive	Sodium flouride, water, methylparaben, polysorbate 80, sodium saccharin, methyl salicylate, propylparaben, sodium hydroxide, spearmint oil, Menthol	Oral-B Laboratories, London, UK
Colgate Peroxyl	Water, sorbitol, ethylic alcohol, hydrogen peroxide, polaxamere 338, polissorbate 20, methyl salicylate, menthol, sodium saccharine.	Colgate Palmolive Ltd, London, UK

**Table 2:** Mean and SD ( $\pm$ ) of Vickers microhardness of dental porcelain immersed in mouthrinses at different times.

Types of porcelain	No.	mouthrinses	Microhardness (GPa); mean (SD) at different time (h)		
			Baseline	24h	96h
Duceram love	10	Listerin	6.09 $\pm$ 0.79	5.98 $\pm$ 0.38	5.84 $\pm$ 0.24
	10	Oral-B Sensitive	6.18 $\pm$ 0.83	6.10 $\pm$ 0.24	6.00 $\pm$ 0.54
	10	Colgate peroxy	6.06 $\pm$ 0.69	6.02 $\pm$ 0.37	5.81 $\pm$ 0.55
	10	Distilled water	6.09 $\pm$ 0.73	6.03 $\pm$ 0.34	6.01 $\pm$ 0.72
IPS e.max ceram	10	Listerin	6.01 $\pm$ 0.73	5.88 $\pm$ 0.26	5.33 $\pm$ 0.40
	10	Oral-B Sensitive	6.01 $\pm$ 0.42	6.01 $\pm$ 0.31	5.83 $\pm$ 0.51
	10	Colgate peroxy	5.95 $\pm$ 0.23	5.88 $\pm$ 0.37	5.67 $\pm$ 0.29
	10	Distilled water	6.05 $\pm$ 0.26	6.01 $\pm$ 0.18	5.88 $\pm$ 0.38
			P=0.91	P=0.53	P=0.78

material. Saliva, food components and beverages have been found to affect dental composites [11]. Mouthrinses, in addition, have been reported to affect the solubility of some restorative materials [12]. The use of mouthrinses has recently become popular as an effective method for prevention and control of caries and periodontal diseases. In addition, mouthrinses are widely used to reduce oral malodor, and implant maintenance [13]. Alcohol in mouthrinses is used as a solvent, taste enhancer and antiseptic agent [14]. Concern has been expressed regarding possible health hazards associated with the use of alcohol containing mouthrinses [15]. Asmussen [6] reported that alcohol in the mouthrinses soften the resin composite restorations. However, it has been found that alcohol-containing and alcohol-free mouthrinses adversely affect the hardness of resin composite, glass ionomer cement and fissure sealant when compared to distilled water [8].

In addition to conventional products containing alcohol, mouthrinses containing hydrogen peroxide have been marketed. However, in this case, besides hydrogen peroxide at low concentrations, these mouthrinses contain alcohol in their composition. It is known that acid solutions may cause changes in the organic composition of resin composites [16,17]. It is speculated that the high oxidative power of bleaching agents, in contact with organic molecules, could change the polymeric bonds and make the composite more susceptible to degradation [1]. Furthermore, changes throughout the inorganic phase may decrease the material's physical properties, such as microhardness and roughness of dental porcelains [18]. Turker and Biskin [5,19] revealed a reduction in the feldspathic porcelain surface SiO<sub>2</sub> content of between 4.82% and 4.44% after exposure to the bleaching agents.

Fluoride treatment has been proved to be beneficial to natural teeth structure by inhibiting dental caries, but at the same time it leads to adverse effects on dental porcelain [19,20]. By design dental porcelain contains large glass component, it can easily be etched and pitted by presence of fluoride ions. The low pH of the fluoride gel can result in the formation of hydrofluoric

acid, which can lead to the etching of restorations that contain silica such as porcelain [18]. Many studies have evaluated the effects of acidic solutions such as topical fluoride gels and bleaching agents on dental materials and ceramics [3,5,18,20,21]. But no study has been conducted on the effect of mouthrinses containing either fluoride, alcohol or hydrogen peroxide on the surface texture of dental porcelains.

The results of this study showed that the studied mouthrinses do not have adverse effect on hardness of Duceram love and IPS e.max ceram. Duceram love consists of an ultra-fine microstructure feldspathic ceram with homogenously distributed lucite crystals. IPS e.max ceram is a glass-crystals in a feldspathic glassy matrix. It was reported that lucite crystals in Duceram love and fluorapatite crystals in IPS e.max ceram have the highest durability compared to the alumina crystals [22]. Hence those ceramics consisting of leucite or fluorapatite were more resistant to acidic agents, such as fruit juices, than aluminous porcelains. However all the acidic foodstuffs affected the ceramic hardness significantly [20].

To further confirm the results of this study, additional researches such as roughness measurement, need to be conducted. Further studies are required to elucidate the degradation effect of mouthrinses on other dental porcelain or to examine the effect in vivo.

## Conclusion

Within the limitations of the present study, it can be concluded that:

1. All the mouthrinses tested in this study did not negatively affect the hardness of the tested dental porcelain.
2. The hardness of the tested ceramic was slightly different between before and after immersion in the mouthrinses.

**Conflict of Interest:** None declared.

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