

# 2824. Enamel Safety Study of an Experimental Tooth Whitening Formulation

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## Introduction

Tooth whitening or bleaching is a popular and established means for removing intrinsic stains through professional treatment. The effect of hydrogen peroxide on tooth enamel has been studied previously, with the greatest concern being the permanent damage to surface hardness and morphology. Duschner *et al*<sup>1</sup> reported on a hydrogen peroxide formulation containing 6% w/w hydrogen peroxide giving no morphological change in structure or hardness of the enamel. This has been substantiated by Pretty *et al*<sup>2</sup> and Sulleman *et al*<sup>3</sup> who have shown no effect on the enamel hardness or morphology with the use of bleaching systems containing up to 35% w/w hydrogen peroxide.

## Objective

The aim of the present *in vitro* study was to investigate the effects of an experimental tooth whitening system (ETWS) on enamel surface hardness and surface morphology compared with a commercially available product and a positive control.

## Methods

### Clinical procedure

Enamel specimens, prepared from sound human teeth, were ground and polished to ensure a uniform and smooth surface. Specimens (n = 50) were randomized based on their baseline Vickers Hardness Number (VHN) into five treatment groups with the following treatment times (treated twice daily):

- 1 ETWS – 45 minutes
- 2 Crest Whitestrips Premium (CWSP) – 30 minutes
- 3 Water – 45 minutes
- 4 Artificial orange juice (AOJ) – 1 minute
- 5 AOJ – 45 minutes.

VHN was measured using a Vickers Hardness Indenter set to indent for 15 seconds at a 500-g load (five measurements per specimen per measurement point).

Specimens were exposed to the treatment as per the regimen detailed above, and rinsed with deionized water for a specified time with light brushing, to remove any of the formulation after treatment. Between treatments, specimens were rinsed and stored in pooled human saliva. AOJ was defined as a 1% w/v solution of citric acid (pH 3.8).

VHN of specimens was measured again after 7, 14, and 28 treatments.

The average specimen microhardness was determined from five indentations on the surface of each specimen, next to the baseline indentations.

Five additional specimens per group were treated in the same manner and collected from each treatment assessment point for surface morphology analysis by scanning electron microscopy (SEM).

## Statistical methods

The mean, standard deviation, and standard error of mean of each parameter for each group were calculated. Statistical analysis of the  $\Delta$  7 Treatments,  $\Delta$  14 Treatments, and  $\Delta$  28 Treatments data was performed with one-way analysis of variance (ANOVA) models using Sigma Stat (3.0) Software. If the ANOVA indicated a significant difference, all pair-wise comparisons between the groups were conducted (Student-Newman-Keuls test).

## Results

- After 7 and 14 treatments, there was no significant difference between the ETWS, CWSP, water, and AOJ treatments (1-minute exposure) (Figure 1).
- After 28 treatments, there was no significant difference between the ETWS and CWSP treatments.
- Treatment with AOJ at either 1 minute or 45 minutes adversely damaged the morphology of the enamel surface (Figures 2-4).
- In contrast there was no significant alteration in surface morphology following 28 treatments (Figures 5-7) with:
  - the ETWS
  - CWSP
  - water.

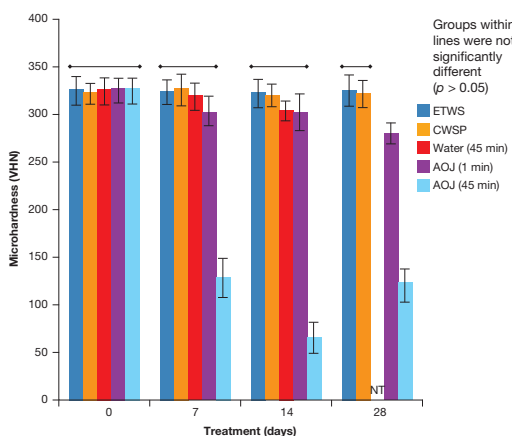


Figure 1. Effect of various treatments on the hardness (Vickers) of tooth enamel. AOJ, artificial orange juice; CWSP, Crest Whitestrips Premium; ETWS, experimental tooth whitening system; NT, not tested; VHN, Vickers Hardness Number.

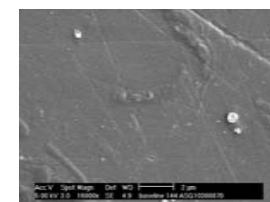


Figure 2. SEM image (16,000x) of enamel untreated (baseline).

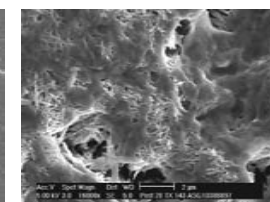


Figure 3. SEM image (16,000x) of enamel treated 28 x 45 minutes with artificial orange juice.

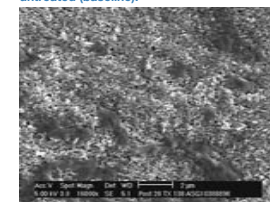


Figure 4. SEM image (16,000x) of enamel treated 28 x 1 min with artificial orange juice.

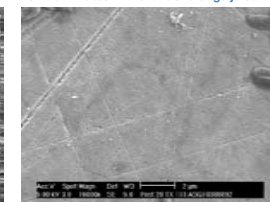


Figure 5. SEM image (16,000x) of enamel treated 28 x 45 minutes with ETWS.

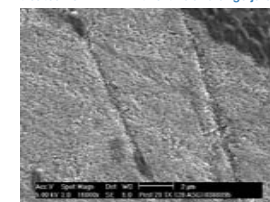


Figure 6. SEM image (16,000x) of enamel treated 28 x 30 minutes with CWSP.



Figure 7. SEM image (16,000x) of enamel treated 28 x 45 minutes with water.

## Conclusions

- No softening of human enamel was observed after ETWS treatments.
- SEM imagery of the enamel showed no significant morphological change after ETWS treatments.
- The study findings are consistent with the published literature regarding hydrogen peroxide effect on enamel.

## References

1. Duschner H, Gotz H, White DJ *et al*. 2006. Effects of hydrogen peroxide bleaching strips on tooth surface color, surface microhardness, surface and subsurface ultrastructure, and microchemical (Raman spectroscopic) composition. *J Clin Dent* 17:72-8.
2. Pretty IA, Edgar WM, Higham SM. 2005. The effect of bleaching on enamel susceptibility to acid erosion and demineralisation. *Br Dent J* 198:285-90.
3. Sulleman M, Addy M, Macdonald E, Rees JS. 2004. A safety study *in vitro* for the effects of an in-office bleaching system on the integrity of enamel and dentine. *J Dent* 32:581-90.

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