

## **An Investigation on the Effect of a New In-Office Bleaching Material on Enamel Surface Morphology, Elemental Composition and Color Change**

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**Objective:** This study investigated the effect of a new in-office bleaching gel at different concentrations of hydrogen peroxide on the tooth surface morphology and color change.

**Methods:** Sound incisors without lesions and decays and including white spots were included in this study. The coronal sections were cut using a diamond disk coupled to a hand-piece under water cooling. The crowns were further sectioned bucco-lingually in two halves. For each incisor, one hemi-section (A) was randomly allocated to receive the bleaching treatment, while the other half (B) acted as the control group. The specimens were randomly allocated into four groups (n=3 per group) based on the bleaching hydrogen peroxide (HP) gel type and concentrations:

Group 1- A was bleached using 6% HP (experimental bleaching gel, BioWhiten ProOffice; Alkaline HP (pH  $\geq$  7.5) and Nano-Hydroxyapatite), while B acted as the control.

Group 2- A was bleached using 12% HP (experimental bleaching gel, BioWhiten ProOffice; Alkaline HP (pH  $\geq$  7.5) and Nano-Hydroxyapatite), B: 10% of Carbamide peroxide (CP) (3.6% of HP) conventional bleaching gel (White Dental Beauty, Novon, Optident).

Group 3- A was bleached using 18% HP (experimental bleaching gel, BioWhiten ProOffice; Alkaline HP (pH  $\geq$  7.5) and Nano-Hydroxyapatite), while B acted as the control.

Group 4- A was bleached using 10% CP conventional bleaching gel, while B acted as the control.

The bleaching agents were applied on all specimens with the same protocol, following the manufacturer's instructions for a duration of 10 minutes in 5 cycles.

Colour measurements were made before and after bleaching procedures.

Enamel surfaces were analyzed using Scanning Electron Microscopy (SEM) to examine the enamel morphology before and after bleaching treatment at x500 and x2000 magnification. In addition, elemental mapping was performed using EDAX from both control and bleached specimens in each group. Data were analyzed using 2-way ANOVA and Tukey's, post-hoc tests ( $\alpha=0.05$ ).

**Results:** In all groups, bleached enamel surface changes were observed histologically. In Group1a, changes in aprismatic enamel were more prominent, structural losses in prisms and morphological changes in interprismatic areas and continuity were found more clearly in Group3a. Differences in images are due to the variance depth of sample profile. The color changes were noted in the Table.1.

### **Conclusions:**

As a result of bleaching, changes in enamel surface were more prominent in Group 3a (18% HP). It can be concluded that the changes in the enamel surface are minimal and may potentially minimize the hypersensitivity related complications commonly occurred in clinical practice. However, further studies are required to obtain long-term results.

Color Change	Before Appl	After Appl	Before Appl	After Appl	Before Appl	After Appl	Before Appl	After Appl	Before Appl	After Appl
	Group 1a (6% HP)		Group 2a (12%HP)		Group 2b (10%CP)		Group 3a (18% HP)		Group 4a (10% CP)	
1	2M1 A1	2M1 A1	2M1 A1	1M1 B1	2M1 A1	1M1 B1	1M1 B1	0M1 B1	1M2 A2	1M2 A1
2	2M1 A1	1M1 B1	2M1 A1	1M1 B1	2M1 A1	1M1 B1	1M1 B1	0M2 B1	3M2 B3	0M3 B1
3	4M1 C4	2M1 C2	2M1 A1	0M2 B1	2M1 A1	0M2 B1	4M3 A4	2M1 A1	2M1 A1	0M3 B1

**Table. 1** Color values of the samples before and after application.

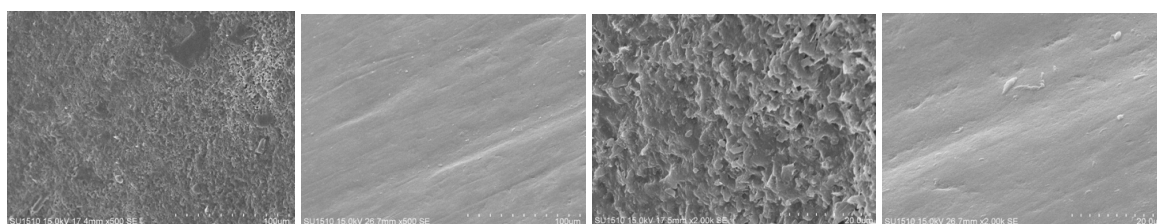


Fig 1a-d. a, b Group 1 a (6% HP and control), Sample 1 at Magnification c) 500 and d) 2000.

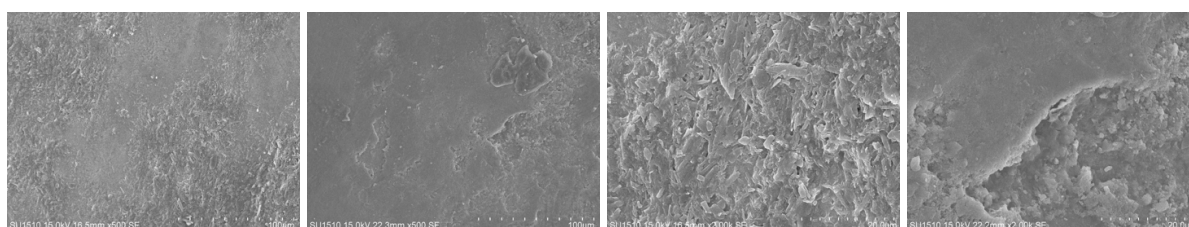


Fig 2a-d. a, b Group 1 a (6% HP and control), Sample 2 at Magnification c) 500 and d) 2000.

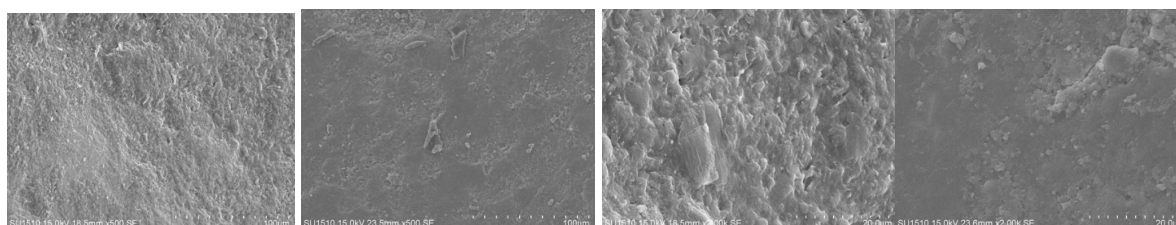


Fig 3a-d. a, b Group 1 a (6% HP and control), Sample 3 at Magnification c) 500 and d) 2000.

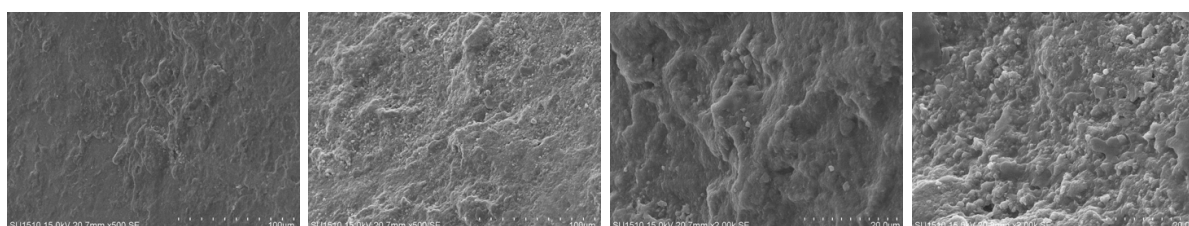


Fig 4a-d. a, b Group 2 a (6% HP and control), Sample 1 at Magnification c) 500 and d) 2000.

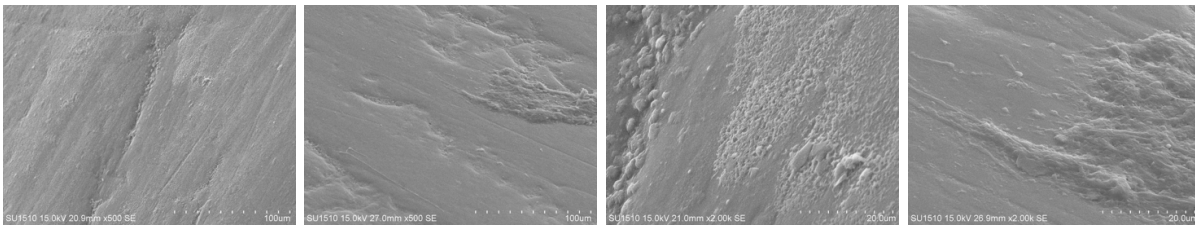


Fig 5a-d. a, b Group 3 a (6% HP and control) Sample 1 at Magnification c) 500 and d) 2000.

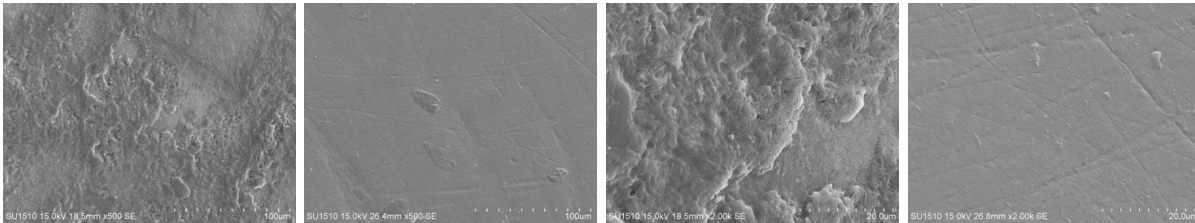


Fig 6a-d. a, b Group 3 a (6% HP and control) Sample 2 at Magnification c) 500 and d) 2000.

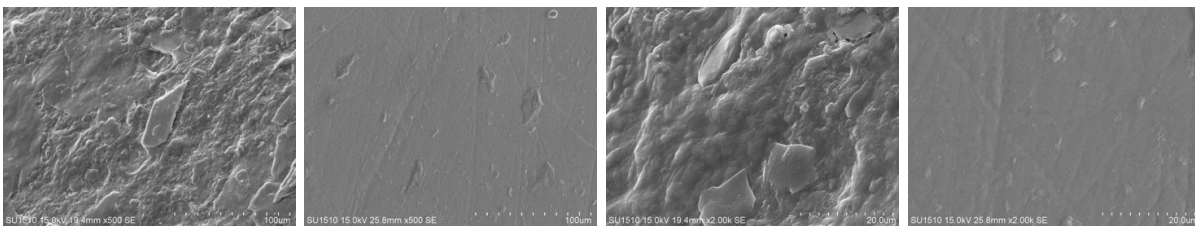


Fig 7a-d. a, b Group 3 a (6% HP and control) Sample 3 at Magnification c) 500 and d) 2000.

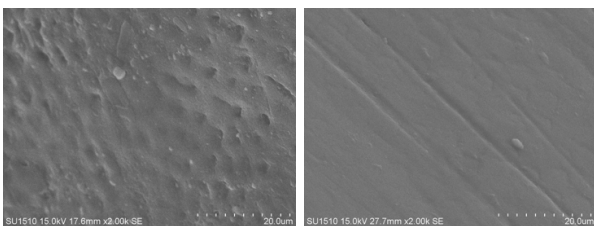


Fig 8a-b. a, b Group 4 a (6% HP and control) Sample 1 at Magnification 2000.

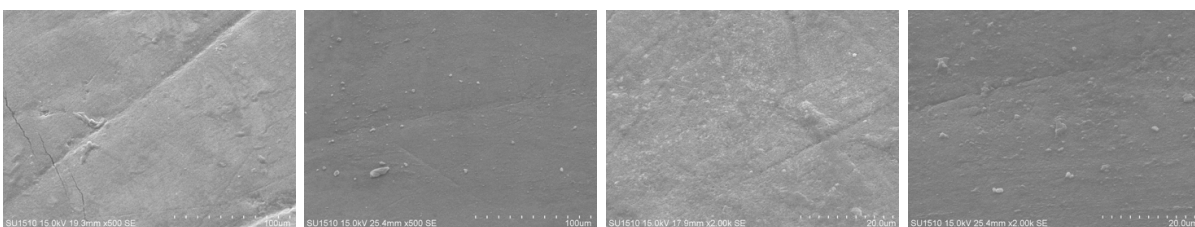


Fig 9a-d. a, b Group 4 a (6% HP and control) Sample 2 at Magnification c) 500 and d) 2000.

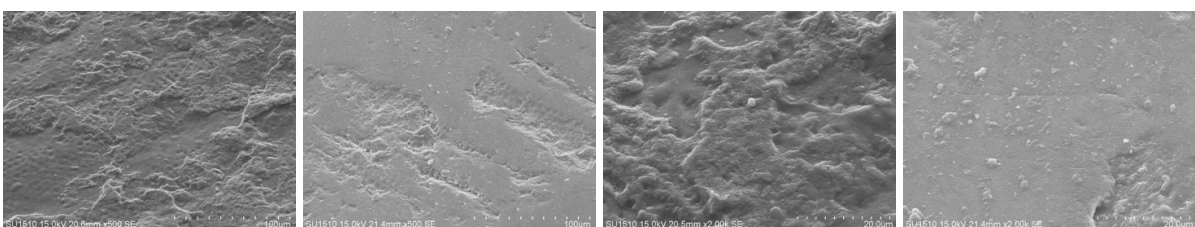


Fig 10a-d. a, b Group 4 a (6% HP and control) Sample 3 at Magnification c) 500 and d) 2000.

Map Sum Spectrum	Group 1a_2000 (6% HP)		Group 1b_2000 (Control)	
	Weight %	Weight % Sigma	Weight %	Weight % Sigma
O	61.42	0.44	67.78	0.25
P	10.66	0.16	9.29	0.09
Ca	21.18	0.25	17.18	0.13
Zn	6.13	0.23	5.13	0.15
Ti	0.00	0.00	0.00	0.00
V	0.03	0.05	0.03	0.03
Fe	0.00	0.00	0.02	0.04
Zr	0.00	0.00	0.00	0.00
Mg	0.17	0.04	0.14	0.03
K	0.08	0.04	0.04	0.02
Cl	0.34	0.04	0.39	0.02
Total	100.00		100.00	

Map Sum Spectrum	Group 2a_2000 (12% HP)		Group 2b_2000 (3,6% HP)	
	Weight %	Weight % Sigma	Weight %	Weight % Sigma
O	66.37	0.19	61.09	0.16
P	10.00	0.07	10.92	0.06
Ca	18.78	0.11	22.43	0.10
Cl	0.22	0.02	0.23	0.01
Zn	4.26	0.10	4.91	0.08
Ti	0.00	0.00	0.00	0.02
V	0.02	0.02	0.00	0.00
Zr	0.00	0.00	0.00	0.00
Mg	0.21	0.02	0.22	0.02
K	0.11	0.02	0.14	0.01
Fe	0.03	0.03	0.05	0.03
Total	100.00		100.00	

Map Sum Spectrum	Group 3a_2000 (18% HP)		Group 3b_2000 (Control)	
	Weight %	Weight % Sigma	Weight %	Weight % Sigma
O	60.04	0.23	67.78	0.25
P	12.11	0.09	9.29	0.09
Ca	24.35	0.15	17.18	0.13
Ti	0.00	0.00	0.00	0.00
V	0.04	0.03	0.03	0.03
Zr	0.00	0.00	0.00	0.00
Mg	0.16	0.02	0.14	0.03
K	0.10	0.02	0.04	0.02
Fe	0.03	0.04	0.02	0.04
Zn	2.80	0.10	5.13	0.15
Cl	0.38	0.02	0.39	0.02
Total	100.00		100.00	

Map Sum Spectrum	Group 4a_2000 (3,6% HP)		Group 4b_2000 (Control)	
	Weight %	Weight % Sigma	Weight %	Weight % Sigma
O	61.09	0.16	67.78	0.25
P	10.92	0.06	9.29	0.09
Ca	22.43	0.10	17.18	0.13
Cl	0.23	0.01	0.39	0.02
Zn	4.91	0.08	5.13	0.15
Ti	0.00	0.02	0.00	0.00
V	0.00	0.00	0.03	0.03
Zr	0.00	0.00	0.00	0.00
Mg	0.22	0.02	0.14	0.03
K	0.14	0.01	0.04	0.02
Fe	0.05	0.03	0.02	0.04
Total	100.00		100.00	