The Effect of Ozone on Surface Morphology and Tubule Occlusion of Hypersensitive Dentin

Thesis
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BY

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This study was conducted to evaluate the effect of ozone and its combination with fluoride or oxalate desensitizing agents on tubular occlusion of hypersensitive dentin. Results for qualitative Environmental Scanning Electron Microscope (ESEM) examination are presented in figures 13 to 24 and 25 to 28 for Scanning Electron Microscope (SEM) examination while that for quantitative image analysis are presented in tables 4 to 9 and figures 29 to 35.

I. Qualitative assessment of dentinal tubules

I. A Environmental scanning electron microscope:

Qualitative assessment, using ESEM, for a representative specimen for each subgroup before and after treatment is presented. In the control group, a typical ESEM photomicrograph after citric acid treatment is shown in (figure 13). The specimen reveals a smooth appearance with opened tubules' orifices, simulating hypersensitive dentin. Dentin specimens were immersed in distilled water as control and representative ESEM photomicrographs is shown in (figure 14). The control specimens maintained their condition and no significant changes were observed between that before and after immersion in distilled water. On the other hand, ESEM examination of specimens treated with ozone (figure 16) showed slight widening in the lumen of dentinal tubules as compared to the ESEM photomicrograph taken before ozone application (figures 15).

Figures (17 and 18) show representative ESEM photomicrographs for a dentin specimen before and after treatment with fluoride. Some crystals are seen loosely attached to the tubules. However, no precipitates seem to occlude the dentinal tubules which

appear opened and exposed but slightly narrower than before treatment. In contrast, the application of potassium oxalate on dentin surface (figure 20) reveals obliteration of dentinal tubules compared to the widely patent dentinal tubules before treatment (figure 19). With oxalate application, a homogenous layer is shown on the surface of dentin occluding the majority of dentinal tubules orifices. Spherical and crystal-like inclusions are also observed on the surface (figure 20).

Figures (21 and 22) show representative photomicrographs of dentin surface before and after treatment with ozone followed by fluoride application. Figure (22) reveals partial occlusion of dentinal tubules with narrowing in the apertures of the dentinal tubules, but not complete obliteration. On the other hand, the dentin surfaces treated with ozone followed by application of potassium oxalate is presented in (figure 24) compared to before treatment (figure 23). It could be observed that precipitates of oxalate crystals covered the treated dentin surface and occluded the orifices. However, some dentinal tubules opening remained visible with slight narrowing of tubules apertures than before treatment.

I. B <u>Scanning electron microscopic examination:</u>

SEM assessment of representative specimens treated with fluoride or oxalate is presented in figures (25 to 28). In fluoride treated specimen; examination of the surface topography revealed a relatively smooth thin surface coating over some areas of the treated surface (figure 25). Most of the dentinal tubules showed narrowing in the tubule aperture due to fine precipitates on the tubular walls. However, full tubular occlusion was very rare.

Fractured fluoride-treated specimen (figure 26), showed that this surface coating had fine deposits adhered to the surface (solid white arrow). It is also shown that this fine coating did infiltrate the dentinal tubules at various depths and appear to be in intimate contact with the dentinal tubules. Some tubules were infiltrated by the precipitate for approximately 10 μm (solid black arrow) but not to the full length of the dentinal tubule (dotted white arrow). Other tubules appear to be narrowed to its full visible length by the infiltrate which appear to line the lumen of the tubule (dotted black arrow).

On the other hand, SEM examination of the surface topography of the oxalate-treated specimen (figure 27) reveals crystalline rectangular, rod-shaped aggregates with different dimensions. Angular and cluster-like crystals are deposited on the dentin surface hiding most orifices of the dentinal tubules. Some tubules are barely visible. Fractured longitudinal section (figure 28) reveals that these deposits formed a dense mass on the surface of dentin (solid white arrow), occluding the tubule entrance and firmly attached to the dentinal tubules and intertubular dentin to an approximate depth of 7 μm (solid black arrow). Below this depth, some oxalate crystals or aggregates (dotted black arrow) was found plugging the tubules but did not penetrate, however, more than approximately 14 μm inside the tubules. The crystals appear to be larger than the diameter of the deeper portion of the tubule which was probably not affected by the superficial demineralization by citric acid.

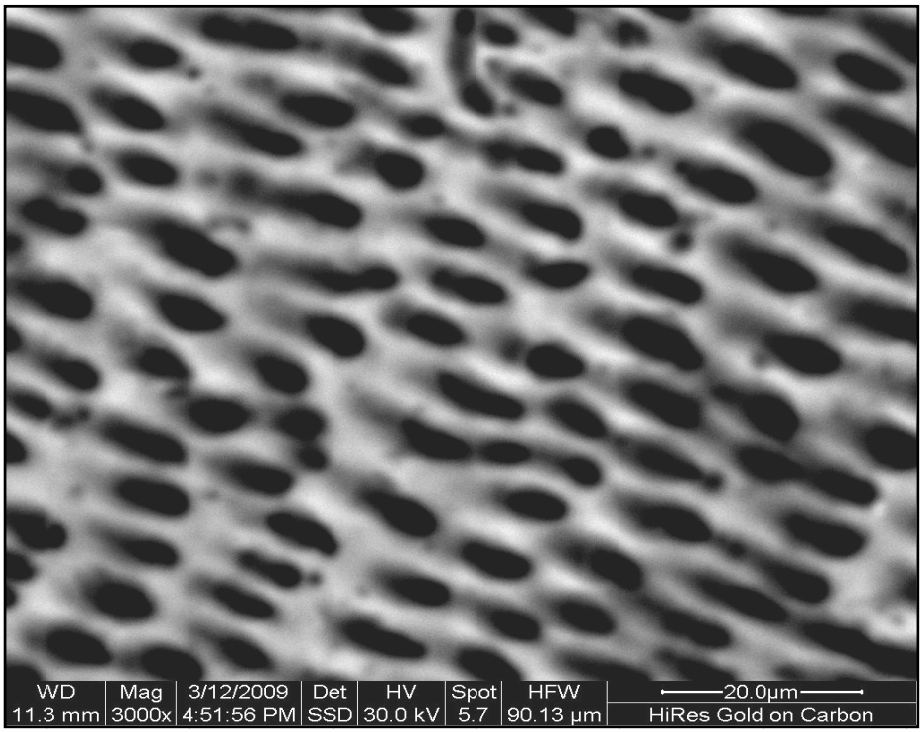

Figure (13): ESEM photomicrograph representing control dentin specimen after treatment with citric acid (3000x)

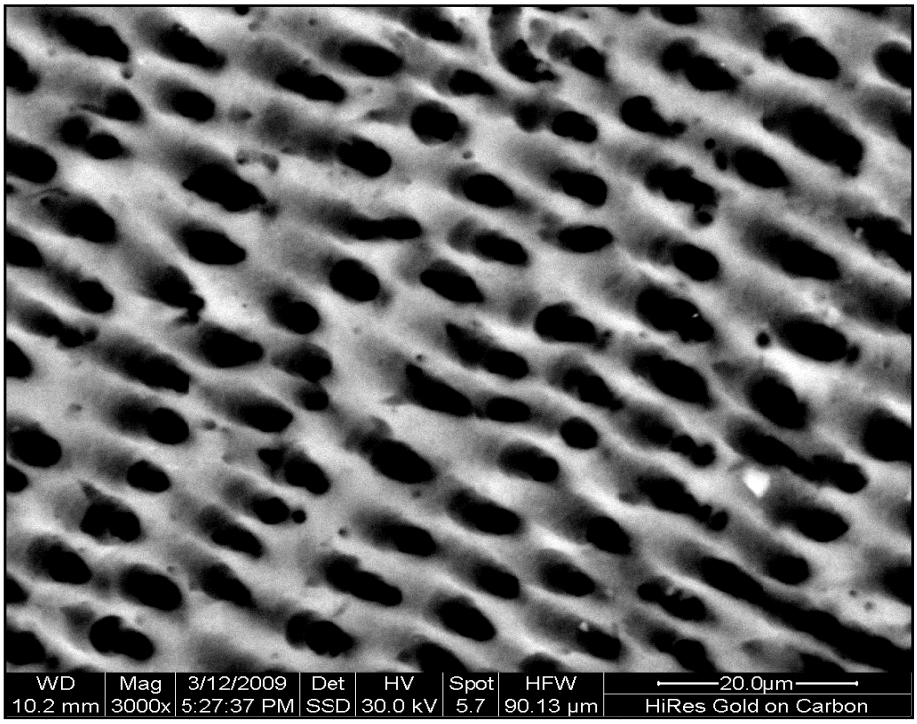

Figure (14): ESEM photomicrograph representing control dentin specimen after immersion in distilled water (3000x)

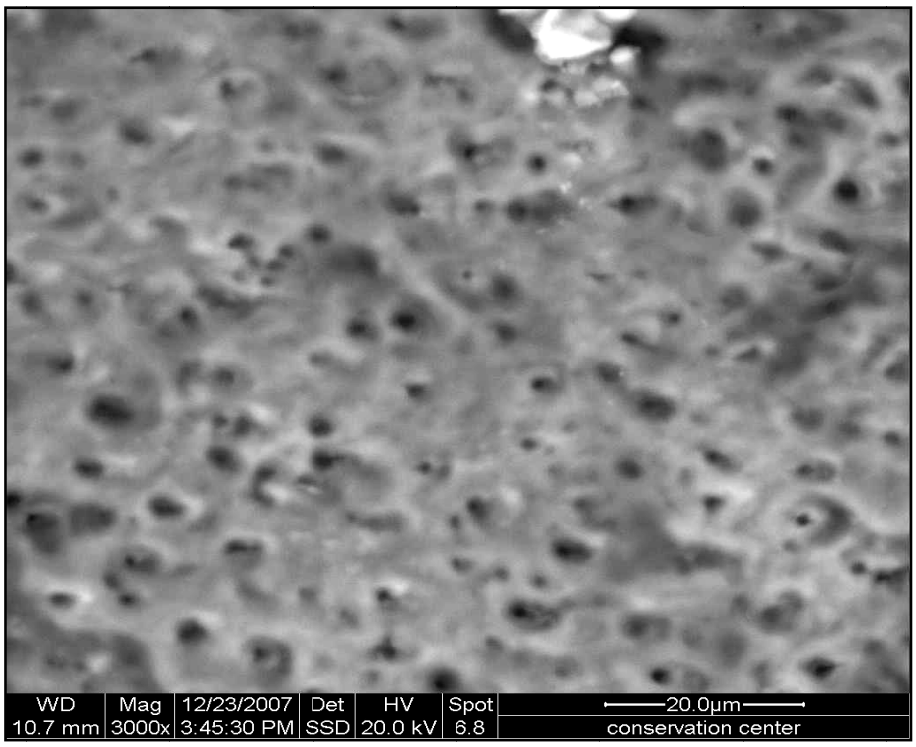

Figure (15): ESEM photomicrograph representing dentin specimen before application of ozone (3000x)

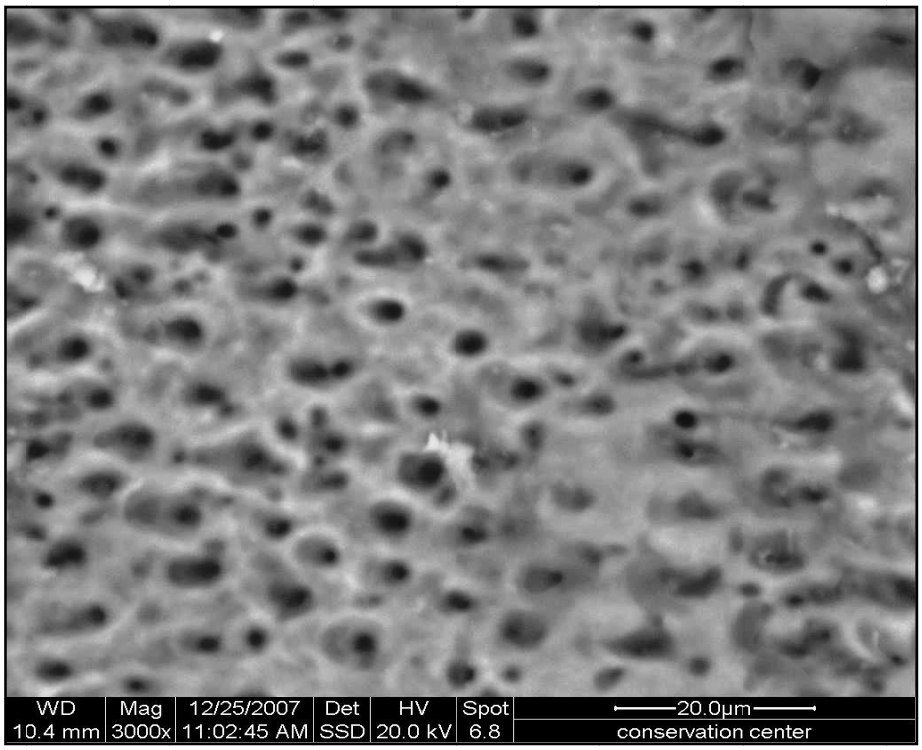

Figure (16): ESEM photomicrograph representing dentin specimen after ozone application (3000x)

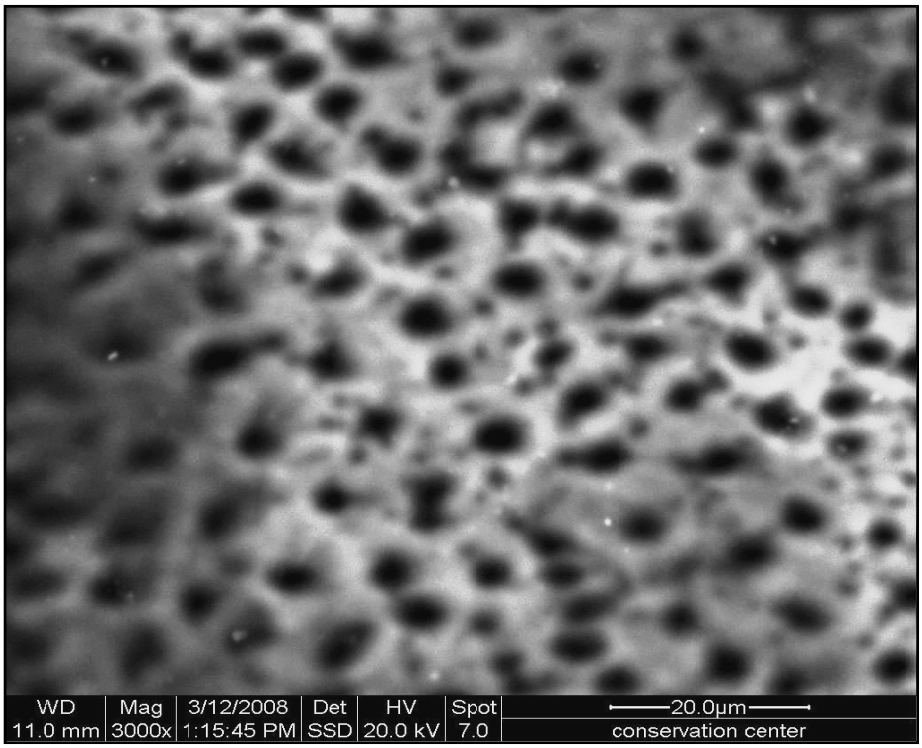

Figure (17): ESEM photomicrograph representing dentin specimen before fluoride application (3000x)

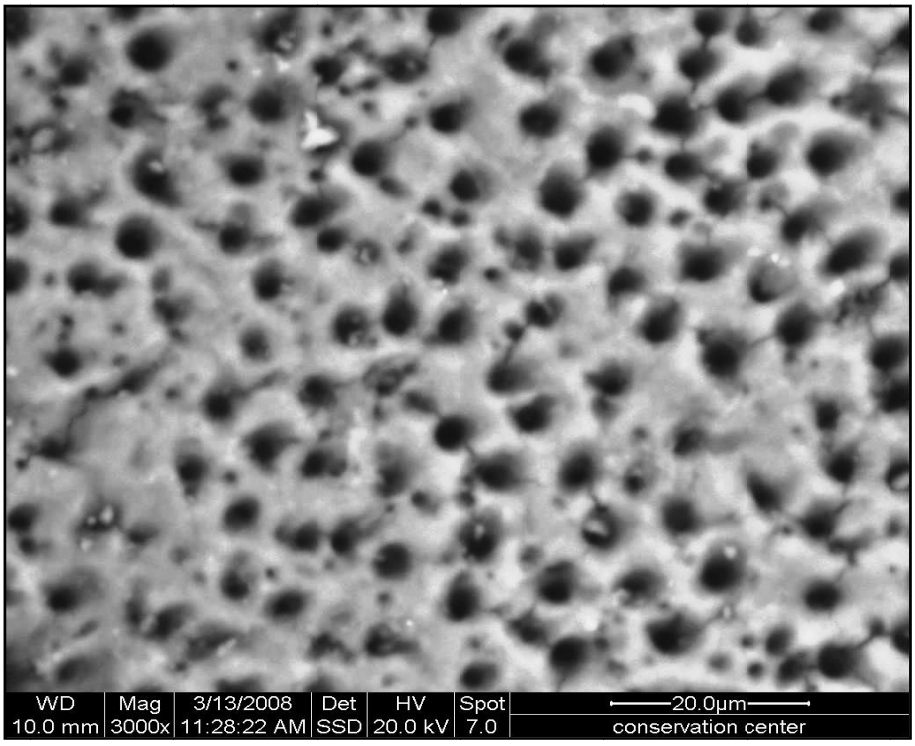

Figure (18): ESEM photomicrograph representing dentin specimen after fluoride application (3000x)

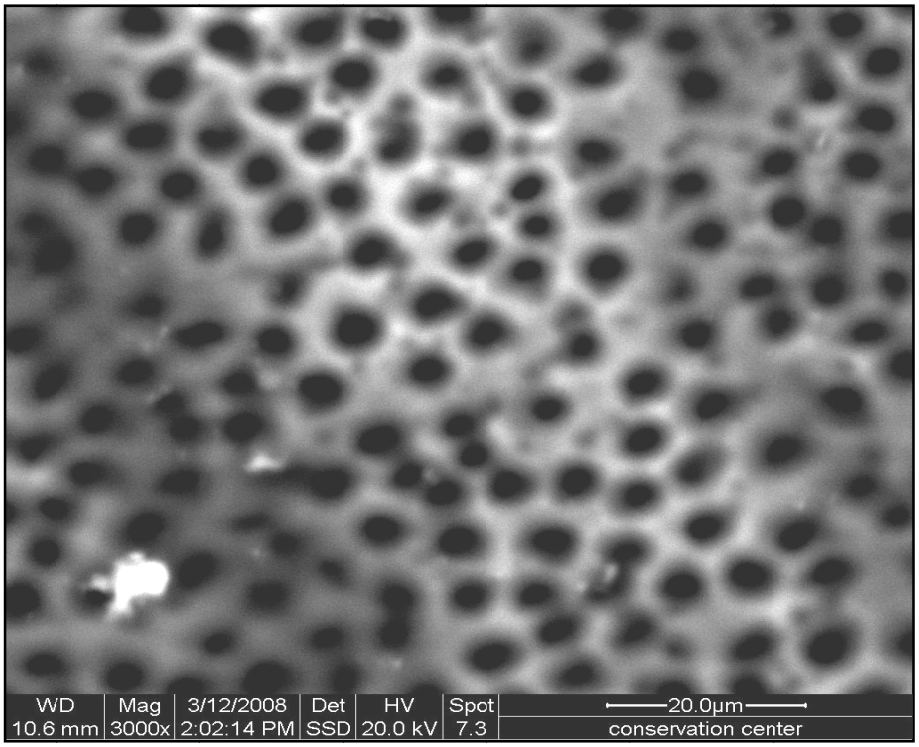

Figure (19): ESEM photomicrograph representing dentin specimen before potassium oxalate application (3000x)

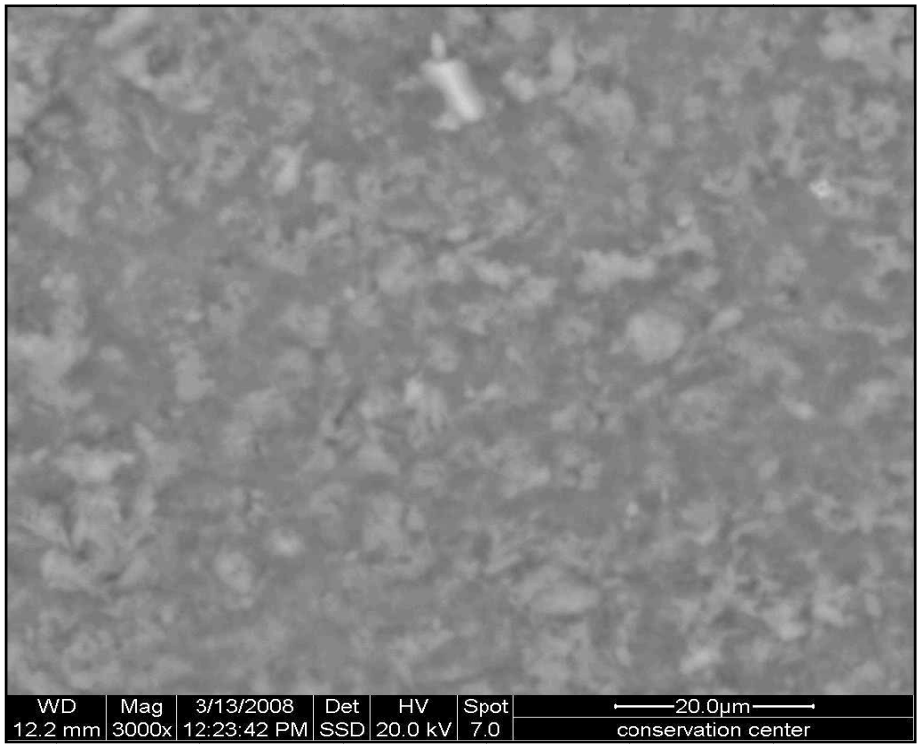

Figure (20): ESEM photomicrograph representing dentin specimen after potassium oxalate application (3000x)