Surface Roughness of Restorative Materials after Tooth Whitening

An Atomic Force Microscopy Study

This in vitro study was conducted to evaluate the effect of tooth whitening on the surface roughness of dental restorative materials using AFM. Two hybrid resin composites and nano-ionomer were fabricated in samples with 2 mm thickness and 6 mm diameter. No changes in roughness was observed for all three materials tested after 14 days of bleaching with 20% carbamide peroxide (CP), compared to the control group. It can be concluded that 20% CP home bleaching did not cause changes in surface roughness of the tested materials.

Tooth whitening has gained considerable acceptance among dentists and patients as a simple, effective and safe procedure to lighten discolored teeth. The principle of tooth whitening is degrading of peroxides from hydrogen peroxide or its compounds such as carbamide peroxide (CP) into unstable free radicals. These radicals are further broken down into large pigmented molecules either through oxidation or reduction reaction [1]. This process changes the chemical structure of the interacting organic substances of the tooth, which results in the change in color. Composite resin and glass ionomers are the most popular dental restorative materials. They offer superior esthetics, require minimal tooth preparation, and are widely used for anterior and posterior restorations. Recently a nanofilled resin composite and glass ionomer were introduced and exhibit a high initial polish while retaining this over time, combined with excellent physical properties [5]. In composite resin technology, particle size and quantity are crucial when determining how to best utilize the restorative materials. The filler particle size, distribution, and the quantity incorporated, dramatically influence the mechanical properties and clinical success of composite resins [6].

Objectives

This in vitro study was conducted to evaluate the effect of tooth whitening on the surface roughness of dental restorative filling materials using atomic force microscopy (AFM).
Methods
Two nano hybrid and micro hybrid resin composites and one nano-ionomer were used in the present study. Samples were fabricated in a 2 mm thick plexiglass with a circular opening of 6 mm.

A total of 30 samples were prepared, ten samples (n=10) for each test material. Group I (n=10), was filled with Filtex Z350 XT nano hybrid composites (3M-ESPE, USA), Group II (n=10) with Estelite Σ micro-hybrid composites (Tokuyama, Japan), and Group III (n=10) with Ketac N100 nano ionomer cements (3M-ESPE, USA). All samples were light-cured from the top and bottom using an Elipar Freelight-2, according to the manufacturer’s instructions. The nano ionomer cement after placement was light-cured for 20 s, while the resin composite materials light-cured for 20 seconds each increment. All samples were then polished using Sof-Lex and a slow-speed hand piece. After polishing, the samples were cleaned ultrasonically using a Sonica 2200 ETH for 5 minutes and then stored in distilled water at 37°C for 24 hours prior to the bleaching treatment. The specimens were subjected to bleaching agent following the manufacturers’ instructions. Samples in subgroup A (control group) were not bleached but stored in a vibrating distilled water bath for 14 days at 37°C. Samples in subgroup B were subjected to Opalescence home bleaching PF a 20% CP four hours per day, for 14 days. Samples from each group were subjected to surface roughness evaluation using AFM. The mean surface roughness was assessed by contact mode. Five different randomly selected areas were scanned with an area of 40 Å~ 40 μm and resolution of 512 Å~ 512 pixels to obtain surface roughness values (Ra). Ra analysis was done by Scan Atomic SPM control software. Then, three-dimensional (3D) images with 10 Å~ 10 μm sizes were acquired for each group of materials.

Results and Discussion
There was no statistically significant change in roughness for all three materials tested after 14 days of bleaching with 20% CP, compared to the control group. The AFM method senses any irregularities on the surface of the specimen and in this study no significant differences between the materials were recorded. This is in agreement with findings of de A. Silva et al. [2]. However, our data contradict Hafez et al. [3], who reported an increased surface roughness of composites resin, which they determined, depended on the bleaching agent as well as the type of material tested.

Conclusion
It can be concluded that 20% CP home bleaching did not cause changes in surface
roughness of the three tested materials. The AFM evaluation of surface roughness observed in the 3D images proved to be an effective technique. For the dental society, this result gives information to the dental practitioner regarding the effect of bleaching to the new available tooth colored filling materials. These findings are important for dental practitioners to choose an appropriate material in tooth whitening treatment, for the benefit of patients.

References

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