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Evaluation of Thermal Behaviors and Some Mechanical Properties of Heat Cured Denture Soft Liner Reinforced by Halloysite Nanotubes

A thesis
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Abstract

Back ground: It is commonly agreed that the commercially available heat-cured acrylic based soft lining material are far from ideal because of low thermal conductivity, poor tear and bonding denture base with the soft lining. Therefore, there is a need to improve such properties of these materials.

Aim of the study: The purpose of this study was to assess the effect of adding different percentages of halloysite nanotubes into acrylic-based heat-cured soft denture lining material on the thermal conductivity, thermal diffusivity and some of mechanical properties including shear bond strength, tear strength, hardness and surface roughness.

Materials and methods: Halloysite nanotubes (HNTs) with concentration of 0%, 0.75% and 1% by weight were incorporated into the soft liner material. Firstly, HNTs powder was dispersed into the monomer of the soft liner by using probe sonication apparatus and then, measured amount of the soft liner's powder blended into this suspension. One hundred and fifty specimens were prepared which were divided into five groups according to the tests to be performed. Each group consists of thirty specimens (10:control, 10: with 0.75% halloysite nanotubes addition and 10 with 1% halloysite nanotubes addition).

Scanning electron microscope was used to show the dispersion of halloysite nanotubes within the polyethylmethacrylate soft liner matrix and energy dispersive X-ray spectroscopy analysis was performed to display the percentages of composite filler of both weight and atoms.

To assess the chemical interaction between HNTs and the soft liner, Fourier transform infrared spectroscopy analysis was applied. X-ray diffractometer was also used to study crystal structures of nanoparticles. Moreover, some of the physical and mechanical properties of the HNTs / soft liner composite were investigated including thermal conductivity, thermal diffusivity, shear bond strength, tear strength, shore A hardness and surface roughness.

The results of this study were statistically analyzed using one-way ANOVA, Dunnett’s T3 and Tukey highly significant difference tests at P

value of > 0.05 was considered statistically non-significant, ≤ 0.05 was considered significant and ≤ 0.01 was considered as highly significant.

Results: Addition of 0.75% and 1% of HNTs into PEMA soft liner showed a highly significant increase of thermal conductivity, while a non-significant increase of thermal diffusivity was observed. In addition, the results of shear bond strength after addition of 0.75% HNTs indicates a non-significant increase whereas for 1% recorded a highly significant increase. The results of tear strength (after addition 0.75% of HNTs were significantly increased in comparison to control group while after addition 1% were a highly significant increased). Shore A hardness registered a highly significant increase; yet, the results for surface roughness observed a non-significant change.

Conclusion: The addition of HNTs into heat cured acrylic –based soft denture liner material could improve thermal conductivity, shear bond strength and tear strength properties, although thermal diffusivity and surface roughness were not affected as the concentrations of the nanoparticles increases. Yet, the hardness was highly significantly increased.