

Effect of Modified Zirconium Oxide Nano-Fillers Addition on Some Properties of Heat Cure Acrylic Denture Base Material

A Thesis

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Abstract

Polymer nanotechnology represents a new field in nano science recently, polymer nano-composite attracted great attention especially because of their unexpected hybrid properties that are synergistically derived from the two components.

The object of this study was to survey the effect of addition of TMSPM-modified zirconium nano particles on improvement of abrasive wear resistance of heat cure acrylic after brushing with different mechanical denture cleansers (water, water and soap, denti-pur gel and colgate tooth paste), in addition to other some properties of heat cure acrylic resin also comparison the abrasivity for each of these denture cleansers.

Zirconium oxide nano fillers modified by a silane coupling agent Tri(methoxysilyl) propylmethacrylate (TMSPM) before dispersed and sonicated in monomer(MMA) in different percentage 2%, 3%, 5% by weight, then mixed with acrylic powder as general conventional method.

Three hundred and twenty (320) specimens were prepared for this study. They were divided in to 5 main groups according to the test used. For each test 4 subgroups (three for different weight percentage of zirconia and one for control) where each sub group contain ten specimens to be tested, except for abrasive wear test where each subgroup consisted of 40 specimens, each subgroup of abrasive wear test was further subdivided in to four subgroups according to the type of denture cleaning materials where each sub group consisted of 10 specimens. All specimens where cured by using short curing cycle (90 min. at 74°C followed by 30 min. at 100°C).

Evaluation was made by measuring abrasive wear by volume loss after brushing the specimens with different mechanical denture cleansers (water, water and soap, denti-pur gel, colgate), water sorption and solubility, porosity,

tensile and fatigue strength test. Scanning electron microscope techniques additionally used to analyze the fracture surface of fatigue test and estimate the dispersion and distribution of the nano-ZrO₂ particles.

The results showed highly significant increase in abrasive wear resistance with 3wt% and 5wt% percentage of nano fillers while non significant with 2wt% nanofillers with all groups of denture cleansers. Non-specific denture cleanser(colgate) have high abrasive effect on acrylic resin as compared with cleaning by water while dento-pur gel have no significant abrasive effect on resin as compared with cleaning by water(control and experimental).Highly significant decrease in both water sorption and solubility test in all groups. Significant decrease in porosity in 3wt% and 5wt% but no significant in 2wt% ZrO₂ nano filler. Highly significant increase in both tensile and fatigue strength in all groups but slightly decreased in 5% as compared with 3wt% but still high significant as compared with control group.

In conclusions, according to the obtained results in this study, incorporating the modified nano-zirconia into acrylic resin results in improvement in abrasive wear resistance, tensile and fatigue strength in addition decrease in water sorption, solubility and porosity of heat cure denture base resin.