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College of Dentistry

Effect of addition ZrO_2-Al_2O_3 nanoparticles mixture on some properties and denture base adaptation of heat cured acrylic resin denture base material

A Thesis

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Abstract

Statement of problem:

Poly methyl methacrylate (PMMA) is one of the most used polymers as a denture base material. it has some disadvantages in some mechanical properties such as low flexural and impact strength. Also, The adaptation of the denture is important for retention andstability of denture beside the importance of mechanical properties. Nano composite materials based on polymers are widely used in dental restorative martials.

Aim of the Study:

The purpose of this study was to reinforce and improve biocompatibility and adaptation of acrylic resin denture base material (PMMA) by evaluate the effect of surface treated (silanized) ZrO_2-Al_2O3 nanoparticles mixture addition on impact strength, transverse strength, surface hardness, surface roughness and denture base adaptation of heat cured acrylic resin denture base material.

Materials and methods:

100 acrylic resins specimens were fabricated and divided into five groups according to the test (each group consist of 20 specimens) each group was subdivided into 2 sub-groups (control group and experimental group) each subgroup consist of 10 specimens. Experimental group included the addition of 2wt.% mixture of (ZrO_2-Al_2O_3) by weight to PMMA powder, in ratio (2:1 ZrO_2:Al_2O_3) added to PMMA liquid and mixed by probe sonicater apparatus for 3 minutes before mixing with PMMA powder. The effect of this addition was evaluated on: the impact strength measured by Charpy's impact testing machine, the transverse strength measured by Instron testing machine, surface hardness measured by shore D durometer, surface roughness measured by Profilometer and denture base adaptation measured by measuring the gap between denture base and master cast at 3 points (A:deepest point of the left vestibule, B: left ridge crest and C: midline point) by digital microscope for two intervals, first, immediately after deflasking and sectioning 5 mm away from the posterior end

of the cast, and second after 14 days of water immersion. Denture base adaptation was also evaluated by computerized tomography (CT)**.** The results were statistically analyzed using independent sample t-test.

Results:

A highly significant increase in impact strength (9.63) Kj/m^2 and transverse strength (93.48) N/mm^2 was observed with the addition mixture of (ZrO_2-Al_2O_3) nanoparticles to (PMMA) at the percentage of 2%wt. (ratio 2:1 ZrO_2:Al_2O_3). A non-significant increase in surface hardness (85.35) and significant increase in surface roughness (1.37) μm was observed. Also at the same addition gap measurement at three points (A, B and C) immediately after deflasking and sectioning showed a significant increase (0.160mm at point A and 0.081mm at point B) and non-significant increase (0.257mm at point C), after 14 days incubation there was a significant increase (0.195mm at point A) and non-significant increase (0.113mm at point B and 0.301mm at point C). CT evaluation showed that the gap between the denture base and master cast (control and experimental groups) increased from the anterior to posterior side of palate and from the alveolar ridge to the mid palatal line and vestibule areas.

Conclusion:

The addition 2wt.%mixture of (ZrO_2-Al_2O_3) nanoparticles to heat cure acrylic resin denture base material improved the impact strength, transverse strength and surface hardness of this material at the same time increased the surface roughness. On the other hand there was an increase in gap measurement (decrease denture base adaptation) with the addition mixture of (ZrO_2-Al_2O_3) nanoparticles.