

**The Effect of addition Nano particle  
ZrO<sub>2</sub> on Some Properties of auto clave  
processed heat cure acrylic denture  
base material**

A thesis

Submitted to the council of College of Dentistry / University  
of Baghdad in partial fulfillment for the requirement to award  
the degree of Master of Science in Prosthodontics.

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2014 A.D.

1435A.H.

# Abstract

## **Statement of the problem:**

Polymethylmethacrylate (PMMA) is used in denture fabrication and considered as the most reliable material for the construction of removable prosthodontic appliances. The material is far from ideal in fulfilling the mechanical requirements and the effect of autoclave processing has not been fully determined.

## **Aim of the Study:**

The purpose of this study was to evaluate the effect of addition of salinized( $ZrO_2$ ) Nano fillers in percentages 3%, 5% and 7% on some properties of heat cured acrylic processed the by autoclave and comparative it with 0% (control) group.

## **Materials and methods:**

Free from  $ZrO_2$  addition to control group of heat cured PMMA the silanized ( $ZrO_2$ ) Nano-particles was added to PMMA powder by weight in three different percentages 3%,5% and 7%, mixed by probe ultra-sonication machine.

Two hundred specimens were constructed and processed by autoclave and divided into 5 groups according to the test (each group consist of 40 specimens ) and each group was subdivided into 4 sub-groups according to the percentage of added ( $ZrO_2$ ) nano-particles( with 10 specimens for each subgroups) . The tests conducted were transverse strength, indentation hardness(shore D), Impact strength test, surface morphology and apparent porosity. Surface morphology AFM can provided 3D image and we can know the homogeneity of nanostructure film, also roughness of surface and crystallite size. Scanning electron microscope SEM of control and salinized Nano  $ZrO_2$  fillers with different magnification to show the Nano fillers distribution and it is shaped.

Finite element analysis application to obtain the numerical solution using ANSYS software for the material is structure. The results were statistically analyzed using ANOVA test.

**Results:**

Highly significant increase in impact strength recorded when acrylic (vertex) with 3%, 5% are tested, while anon-significant reduction 7% was observed when group was tested in comparison to control group. Non-significant improvement in transverse strength when 3% ZrO<sub>2</sub> added while 7% showed anon significant reduce. 5% nano ZrO<sub>2</sub> improved transverse strength significant when these groups compared to the control group .Anon significant reduction in the deformity was seen within 3% group specimens and also on a significant increase was recorded when 7% group specimens were tested. 5% nano ZrO<sub>2</sub> reduce the deformity significantly when these groups are compared to the control group. A significant increase in surface hardness was observed with the addition of (ZrO<sub>2</sub>) nano-particles to (PMMA) at the percentage of 3%, highly significant increase at 5% and 7%with addition of modified nano-ZrO<sub>2</sub>.

A non-significant decrease in apparent porosity at 3%,highly significant decrease in apparent porosity at 5% and 7% with addition of modified nano-ZrO<sub>2</sub>. SEM results showed a good distribution of the modified nano-ZrO<sub>2</sub> fillers at 3%, 5% and showed aggregation at 7% in the polymer matrix.

**Conclusion:**

The addition of modified nano-ZrO<sub>2</sub> particles to acrylic resin cured by autoclave improved impact and transverse strength of denture base nano composite containing 5% of nano-ZrO<sub>2</sub>. And this strength decreases with further increase of nano-ZrO<sub>2</sub> filler content. Also addition of modified nano-ZrO<sub>2</sub> slightly increases the indentation hardness and grain size changes in surface morphology was observed with decrease in surface roughness, and the apparent porosity also decrease by addition of nano ZrO<sub>2</sub>percentage increase .