

Ministry of Higher Education  
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# **Effect of nano silicon dioxide addition on some properties of heat vulcanized maxillofacial silicone elastomer**

A thesis

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## Abstract

**Statement of problem:** Silicone elastomer, chemically known as Polydimethylsiloxan (PDMS), is widely used as the material of choice for fabricating maxillofacial prosthesis. It is used because of its biocompatibility, chemical inertness and ease of manipulation. However, silicone properties are far from ideal; low tensile and tear strength, insufficient elasticity and degradation of physical and color properties after six months of service are the most undesirable properties. Lately, research has been devoted to enhance maxillofacial silicone properties through the development of a new class of polymeric materials, by incorporating nanoparticles into a polymeric matrix, that offers the strength of the nano-oxides with the flexibility of polymer matrix.

**Purpose:** The purpose of this study was to evaluate the effect of addition of nano SiO<sub>2</sub> on tear strength, tensile strength, elongation at break, hardness and color of Cosmesil M-511 HTV maxillofacial silicone elastomer.

**Materials and Method:** Nano SiO<sub>2</sub> was added to the silicone base in concentrations of 0%, 4%, 5% and 6% by weight. Mixing of the cross linker and curing of the material was done according to manufacturer's instructions. An intrinsic cream color was added to all mixes in amount of 0.5% by weight. Silicone with 0% nano filler served as a control. One hundred and sixty (160) specimens were fabricated and divided into 4 groups according to the tests conducted (Tear, tensile and elongation, hardness and color change tests) with 40 specimens for each test. The color change tests consisted of two tests, spectrophotometer light transmission test and Munsell visual color measurement test, with 20 specimens each. Each group was then divided into four subgroups according to weight percentage of nano filler (control, 4%, 5% and 6%) with 10 specimens each except for the color change tests with 5 specimens each. Tear test was done according to ISO 34-1. Tensile and elongation test was done according to ISO 37. Shore A hardness test was done according to ISO 7619. Visual color

measurement test was done according to ASTM D1535. One sample from each nano filler concentration group was examined under scanning electron microscope to evaluate the efficiency of dispersing method. FTIR test was conducted to evaluate the interaction of nano SiO<sub>2</sub> with the silicone. Statistical analysis was done using one-way ANOVA and Fisher's LSD test.

**Results:** SEM showed well dispersion of nano filler with increasing number of agglomerates at higher filler concentration. FTIR indicated that nano silica interacted with the PDMS through its surface hydroxyl group. All nano silica concentration groups (4%, 5% and 6%) showed a highly significant increase in tear strength, tensile strength and elongation at break compared to the control group. The 5% group showed the highest mean values among other groups. Shore A hardness showed a highly significant increase with all nano silica concentrations with the increase being directly proportional to the increase of nano silica concentration. Spectrophotometer results showed a highly significant decrease in translucency of the material with all nano filler concentrations but this decrease in translucency was visually demonstrated as slight increase in color intensity.

**Conclusion:** Reinforcement of maxillofacial silicone with 5% nano SiO<sub>2</sub> significantly improves all mechanical properties with a slight change of color seen visually.