On Incorporated Maxillofacial Silicone Elastomer

Silicone material is the most popular and widely used in the fabrication of maxillofacial prosthesis. It possesses a texture similar to that of human skin, its flexibility provides the patient with both wellbeing and comfort, it also repels water, blood, and organic materials, thereby eliminating bacterial colonization. In addition, it is resistant to the action of cleaning and is the best commercially available material.

However, problem with silicone material is its color instability and reduced lifetime of extraoral maxillofacial prostheses. For example, it may exhibit modified texture, poorly fitting edges because of shape changes, reduced tear strength, and material discoloration after only 3 months of use. These changes are directly related to patient care during handling and hygiene and the type of exposure that the prosthesis undergoes (air pollution, ultraviolet [UV] rays, and temperature fluctuations).

When a polymer molecule absorbs UV light, this energy promotes instability in the molecular structure. The excess energy is transmitted by excitation from one molecule to another, allowing the first molecule to recover its stability. Therefore, affected groups may return to their original state by releasing energy in the form of longer wavelengths, such as visible light or heat. However, a photochemical degradation occurs when this excess energy is released, contributing to molecule deterioration. This is evidenced by changes in color and brightness, crack formation, and hardening.

Different methods have been tested to prevent this early material deterioration. One of these methods is addition of nanoparticles, such as zinc oxide (ZnO), barium sulfate ($BaSO_4$), titanium dioxide (TiO_2), and cerium oxide (CeO_2). Several studies have confirmed the effectiveness of nanoparticles in improving color stability by blocking the ultraviolet rays and also in improving physical and mechanical properties.

The Nano sized material particles result in the optimization of individual material particle characteristics and control of biological, mechanical, electrical, magnetic, and optical characteristics as well. Nano sized rutile TiO_2 and ZnO are known to have a high ultraviolet (UV) absorbing and scattering effect that results in protection from UV light. Nanosized SiO_2, TiO_2, and ZnO are characterized by their small size, large specific area, active function, and strong interfacial interaction with the organic polymer. Therefore, they can improve the physical properties and optical properties of the organic polymer, as well as provide resistance to environmental stress-caused aging.

As the nanoparticles are smaller than the UV light wavelength, their electrons vibrate when they hit by such radiation, thereby dissipating one portion of the light while absorbing another. Thus, the smaller the nanoparticles, the better the shielding against solar radiation.

Many nanoparticles (zinc oxide (ZnO), barium sulfate ($BaSO_4$), titanium dioxide (TiO_2), and cerium oxide (CeO_2) have been tested to improve the properties of silicone material. Silver nanoparticles also has been used as an antifungal agent but, effect of this nanoparticles on physical and mechanical properties of silicone is unknown.

Several studies evaluated the effect of adding silver nanoparticles in several dental material such as acrylic resin, porcelain, silicone soft liner, etc. And studies have shown that adding silver nanoparticles may have an effect on materials physical properties. In this study, silver nanoparticles are added to the maxillofacial silicone and its effect on physical properties are evaluated.

The purpose of this study was to evaluate the impact of silver nanoparticle incorporation into maxillofacial silicone material's hardness and tear strength after one month of outdoor weathering. The null hypothesis was that, addition of silver nanoparticles into the maxillofacial silicone material did not have any effect on physical properties of the material.