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Effect of Nanosilver on Thermal and Mechanical Properties of Acrylic Base Complete Dentures

Fahimeh Hamedi-Rad*, Tahereh Ghaffari, Baharak Ezzati and Farzad Rezaii

Babol Medical Science University, Iran.

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ABSTRACT

Objective: Polymethyl Methacrylate (PMMA), widely used as a prosthodontic base, has many disadvantages, including a high thermal expansion coefficient and low thermal conductivity, a low elasticity coefficient, low impact strength and low resistance to fatigue. These studies aimed to make an in vitro comparison of the thermal conductivity, compressive strength and tensile strength of the acrylic base of complete dentures with those of acrylic reinforced with nanosilver.

Materials and methods: The silver nanoparticles (10-100 nm) were mixed with heat-cured acrylic resin in an amalgamator in three groups at 0.2, 2 and 5 wt% of AgNPs. Thirty 2 × 20 × 200 mm samples were prepared for tensile strength test, 18 samples containing silver nanoparticle and 12 samples for the control group. Another 30 cylindrical 25 × 38 mm samples were pre-pared for compressive strength test. The last group 30 cylindrical samples were fabricated and thermal conductivity was measured. Scanning electron microscopy was used to verify homogeneous distribution of particles. The powder was manually mixed with a resin monomer and then the mixture was properly blended. Before curing, the paste was packed into steel molds. After curing, the specimens were removed from the molds. One-way ANOVA was used for statistical analysis, followed by multiple comparison tests (Scheffe's post-hoc test). Data were analyzed using SPSS 15 and $P<0.05$ was considered statistically significant.

Results: This study showed that the mean thermal conductivity of PMMA reinforced with nanosilver were significantly higher than the unmodified PMMA ($P<0.05$). By increasing the amount of nanoparticles in the acrylic powder, thermal conductivity further increased.

This study showed that the mean compressive strength of PMMA reinforced with AgNPs was significantly higher than that of the unmodified PMMA ($P<0.05$). It was not statistically different between the groups reinforced with AgNPs. The tensile strength was not significantly different between the 0.2% group and unmodified PMMA and it de-creased significantly after incorporation of 2% and 5% AgNPs ($P<0.05$).

Conclusion: Considering our results suggesting the favorable effect of silver nanoparticles on improving the thermal conductivity and compressive strength of PMMA, use of this material in 0.2% concentration in the palatal area of maxillary acrylic resin dentures is recommended.

Keywords: Polymethyl methacrylate (PMMA), Nanosilver, Thermal conductivity, Compressive strength, Tensile strength, Nanosilver

Corresponding author: Fahimeh Hamedi-Rad, Babol Medical Science University, Iran, E-mail: fahimeh.hamedirad@gmail.com

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