



Mechanical properties of experimental dental Au-Ag-Cu alloys after heat treatments

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Abstract

Objective: The purpose of this study was to determine the mechanical properties of three experimental dental Au-Ag-Cu alloys consisting of 30-50% Au, 30-50% Ag, and 20% Cu after softening and hardening heat treatments.

Materials and methods: Twelve specimens were prepared from three Au-Ag-Cu alloys (50%Au-30%Ag-20%Cu, 40%Au-40%Ag-20%Cu, and 30%Au-50%Ag-20%Cu alloys) and divided into two groups (softening and hardening), all specimens were loaded until fracture occurred using a universal testing machine. Tensile strength, 0.2% proof stress, elastic modulus, and elongation were determined from load-extension curves. The data of mechanical properties were statistically analyzed using One-way ANOVA followed by multiple comparison tests at 95% confidence interval.

Results: No significant differences were found in the elastic modulus between softening and hardening for each experimental alloy, and among the three alloys for each heat treatment ($p>0.05$). The tensile strength and 0.2% proof stress of the hardening groups were significantly higher than those of the softening groups, while the hardening groups had significantly lower elongation than the softening groups ($p<0.05$). The tensile strength of 30Au-50Ag-20Cu alloy was significantly lower than those of the other alloys ($p<0.05$), and no significant differences were found in the tensile strength between 50Au-30Ag-20Cu and 40Au-40Ag-20Cu alloys ($p>0.05$) after softening heat treatment. For the hardening, the tensile strength and 0.2% proof stress of 30Au-50Ag-20Cu alloy were significantly lower than those of the other alloys ($p<0.05$), and no significant differences were found in the tensile strength and 0.2% proof stress between 50Au-30Ag-20Cu and 40Au-40Ag-20Cu alloys ($p>0.05$). No significant differences were found in elongation among the three alloys ($p>0.05$).

Conclusion: The mechanical properties of the three Au-Ag-Cu alloys (50%Au-30%Ag-20%Cu, 40%Au-40%Ag-20%Cu, and 30%Au-50%Ag-20%Cu alloys) could be modified by heat treatments. According to ISO 22674: 2006, and based on the evaluated mechanical properties, all three experimental alloys can be recommended as suitable alloy for crown & bridges and inlays.

Key words: dental Au-Ag-Cu alloys, elastic modulus, elongation, heat treatments, mechanical properties, tensile strength

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