Effects of heat treatment on fatigue strength of cast occlusal rests using Ag-Pd-Cu-Au alloy

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Clinical significance

The breakage of essential structures determines the life of a removable partial denture. The occlusal rest is an important part of denture, supporting occlusal forces. Three heat treatments were investigated to improve the fatigue strength of cast occlusal rest using an Ag-Pd-Cu alloy containing 12wt% Au.

Abstract

Purpose: To avoid early fatigue fracture of the occlusal rest, the optimum heat treatment condition was sought.

Methods: The specimen consisted of an occlusal rest (0.8 mm thickness), vertical minor connector, and denture base connector components. The specimens were conventionally cast, steam cleaned, and finally pickled in a cleaning solution. Heat

treatment conditions were as-cast, manufacturer's instruction, and 800 °C solution treatment. Twenty-six specimens were prepared for each group.

A fatigue testing machine was designed so that the occlusal rest component could be deflected by displacing downward the base connector component. A displacement of 0.46 mm was predetermined from the load-deflection relationship of the specimen. Cyclic load was applied at a frequency of 500 cycles/min, until occlusal rest failures occurred or a preset limit of 2 million cycles was reached. Subsequently, Rockwell hardness was tested on the base surface. The results were statistically analyzed.

Results: All the specimens fractured within the preset limit. The heat treatments significantly influenced the fatigue resistance ($p < 0.003$). A significant difference ($p < 0.05$) was detected between the 800 °C solution treatment and manufacturer's instruction groups. The heat treatments significantly influenced the hardness ($p < 0.001$). A significant difference ($p < 0.05$) was found between the as-cast and manufacturer's instruction groups, and also between the 800 °C solution treatment and manufacturer's instruction groups.

Conclusion: The 800 °C solution treatment was most favorable for the improvement of fatigue resistance. The manufacturer-instructed treatment increased most the hardness but was unfavorable for the fatigue resistance.

Key Words

Fatigue, Ag-Pd-Cu-Au alloy, Heat-treatment, Occlusal rest.