

Influence of heat treatment and veneering on the storage modulus and surface of zirconia ceramic.

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Source

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Abstract

OBJECTIVES:

Glass-ceramic veneered zirconia is used for the application as fixed partial dentures. The aim of this investigation was to evaluate whether the heat treatment during veneering, the application of glass-ceramic for veneering or long term storage has an influence on the storage modulus of zirconia.

METHODS:

Zirconia bars (Cercon, DeguDent, G; 0.5x2x20 mm) were fabricated and treated according to veneering conditions. Besides heating regimes between 680°C and 1000°C (liner bake and annealing), sandblasting (Al(2)O(3)) or steam cleaning were used. The bars were investigated after 90 days storage in water and acid. For investigating the influence of veneering, the bars were veneered in press- or layer technique. Dynamic mechanical analysis (DMA) in a three-point-bending design was performed to determine the storage modulus between 25°C and 200°C at a frequency of 1.66 Hz. All specimens were loaded on top and bottom (treatment on pressure or tensile stress side). Scanning electron microscopy (SEM) was used for evaluating the superficial changes of the zirconia surface due to treatment. Statistical analysis was performed using Mann Whitney U-test ($\alpha=0.05$).

RESULTS:

Sintered zirconia provided a storage modulus E' of 215 (203/219) GPa and $\tan \delta$ of 0.04 at 110°C. A 10%-decrease of E' was found up to 180°C. The superficial appearance changed due to heating regime. Sandblasting reduced E' to 213 GPa, heating influenced E' between 205 GPa (liner bake 1) and 222 GPa (dentin bake 1). Steam cleaning, annealing and storage changed E' between 4 GPa and 22 GPa, depending on the side of loading. After veneering, strong E' -reduction was found down to 84 GPa and 125 GPa.

CONCLUSIONS:

Veneering of zirconia with glass-ceramic in contrast to heat treating during veneering procedure had a strong influence on the modulus. The application of the glass-ceramic caused a stronger decrease of the storage modulus.