

Fracture strength and fractographic analysis of zirconia copings treated with four experimental silane primers

Type: Article

Abstract:

This study evaluated and compared the effect of new four experimental silane coupling agents on the fracture strength of zirconia copings. The findings were supported with fractographic and finite element analyses. All together 125 zirconia copings with a wall thickness of 0.6mm were fabricated on identical nickel-chromium master dies and then divided randomly into five groups (n=25). Four test groups were prepared according the experimental silane primer (labeled: OIWA1, OIWA2, OIWA3 and OIWA4) and one control group without silanization. The silane monomers used were: 3-methacryloxypropyltrimethoxysilane (in OIWA1), 3-acryloxypropyltrimethoxysilane (in OIWA2), 3-isocyanatopropyltriethoxysilane (in OIWA3) and styrylethyltrimethoxysilane (in OIWA4). Tribochemical sandblasting (silica-coating) treatment was performed to the inner surface of the copings in the test groups. All the specimens were silanized at the inner surfaces of the zirconia copings. Self-adhesive universal resin cement was used to cement the copings to the underlying master die. Zirconia copings were vertically loaded on the cusp area until the first crack failure was occurred using Precision Universal Tester at a constant crosshead speed of 1mm/min. Then, the machine was manually controlled to cause more failure to further determine the texture of fracture. Three dimensional finite element analysis and fractography were performed to support the fracture strength findings. Based on the finite element analysis results, zirconia silanized with 3-acryloxypropyltrimethoxysilane showed the highest fracture strength with a mean of 963.75N (SD 4.5N), while zirconia copings silanized with 3-methacryloxypropyltrimethoxysilane showed a mean fracture strength value of 925.65N (SD 2.4N). Styrylethyltrimethoxysilane-silanised zirconia showed mean fracture strength of 895.95N (SD 3.5N). Adding silane coupling agents to the resin-zirconia interface increased the fracture strengths significantly (ANOVA, p<0.05). Silanization with four new experimental silane primers in vitro produced significantly greater fracture strength than the control group not treated with the test silane.

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