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Effects of PVD silica coating and multiple firing on low temperature degradation of a Y-TZ-P ceramic monoclinic content and flexural strength changes

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Aim: Low temperature degradation or aging of zirconia is a negative phenomenon related to the transformation ability of the tetragonal phase. The t-m phase transformation leads to micro and macro cracking of the zirconia. The purpose of the study is to find out the effect of silica coating by Physical Vapor Deposition (PVD) system and multiple firing on Low Temperature Degradation (LTD) and biaxial flexural strength of a Y-TZP ceramic after surface grinding and hydrothermal aging.

Materials & Methods: 90 disc shaped specimens (15 x1.2 mm) were equally divided into nine groups (n=10) according to the test protocols. For each group, a different surface or heat treatments was applied: Aging (LTD), silica coating + LTD, grinding + LTD, grinding + silica coating + LTD, 3 times firing + LTD, grinding + 3 times firing + LTD, 5 times firing + LTD, grinding + 5 times firing + LTD and a control group. Accelerated aging was performed in steam autoclave (134° C, 2 bar) for 12 hours. Following each treatment protocols, X-ray diffraction analysis was used to estimate the relative amount of monoclinic phase and corresponding Transformed Zone Depth (TZD). Additionally, the biaxial flexure test was used to calculate the flexural strength. Statistical analysis was conducted with Kruskal Wallis test and Turkey's multiple comparison test.

Results: The tetragonal-to-monoclinic phase transformation of the Y-TZP ceramic was retarded by the application of PVD silica coating only in the ground surfaces. The lowest monoclinic content was detected in grinding + 5 firing + LTD group. The biaxial flexural strength (MPa) of grinding + LTD group was significantly higher than control and silica coating + LTD groups. There was no significant difference between the other groups.

Conclusion: Multiple firing may be useful to decrease the relative monoclinic content after grinding procedures. PVD silica coating did not change LTD resistance and biaxial flexure strength of zirconia. However, further studies about the treatment of LTD should be made including the examinations on chipping problem in veneer ceramics.

Biography

Rifat Gozneli has completed his PhD in 2004 from Marmara University, Istanbul, Turkey and continued his Post-doctoral studies in Marmara University School of Dentistry. He is now an Associate Professor and also working as a Tutor. He has published more than 20 papers in international and national journals. He has been serving as a reviewer in national journals. He is the Member of Turkish Prosthodontics and Implantology Association and Prosthodontics Academy and Gnathology Association in Turkey.

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