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Evaluation of mechanical properties and cell response of glass infiltrated zirconia after sandblasting

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Zirconia surface modification technique, especially, glass infiltrated zirconia method is one of the most effective method on producing a composite with more desirable properties than the individual components. The aim of this in vitro study was to evaluate the mechanical properties and initial cell response of glass infiltrated zirconia ceramic before and after sandblasting. 100 zirconia specimens were divided into the following 4 groups, according to the surface treatments: untreated zirconia (control), sandblasted zirconia (S), glass infiltrated zirconia (G), and sandblasted glass infiltrated zirconia (GS). Surface roughness (Ra) was determined using a nanosurface 3D optical profiler. Biaxial flexural strength was measured by universal testing machine, according to ISO 6872. Vicker's indentation test was performed to estimate the material hardness (Hv). MC3T3 osteoblast-like cells proliferation and attachment were examined for 1 day and 3 days. Glass infiltration depth, surface morphology, and indentation patterns were characterized under a high-resolution field emission scanning electron microscopy (FE-SEM). One-way analysis of variance (ANOVA) and Tukey's HSD pairwise multiple comparisons were performed on all the test. GS group showed a slight decrease in hardness, but revealed the improvement of flexural strength (686.2 MPa). After sandblasting, GS group had the highest surface roughness (Ra=1.24 μm) compared to the other groups, and supported an enhanced osteoblast cells response than the untreated zirconia. FE-SEM images of the glass infiltrated zirconia surface microstructure showed a smooth surface before sandblasting. After sandblasting, the new surface exhibited roughness with the formation of shallow irregularities. The results of this study indicated the beneficial influence of graded structures in the design of zirconia implant, possibly also all-ceramic crowns and ridges restoration. The glass infiltrating process could be used as a promising method to enhance the mechanical properties with better surface roughness of zirconia implant for osteoblast cells response. Limitation of this study related to the experiment conditions which may different from the actual clinical situation.

Biography

Sang-Won Park received his DDS degree (1985) and PhD (1995) from Chonnam National University, South Korea. Since 2000, he has been a Professor of Prosthodontics, Chonnam National University. He served as Visiting Professor at University of Texas Health Science Center at San Antonio from 2002 to 2003. He is a Prosthodontist, but has the experience of implant surgery and prosthesis over 20 years and his research interests has been focused on implant surfaces and zirconia prosthesis. He has published articles in international peer-reviewed journals and is co-author of several books and serves on the editorial board of Journal of Advanced Prosthodontics. He was the Chairman of Dept. of Prosthodontics and a Director of Chonnam National University Dental Hospital.

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