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Effect of surface treatment on wettability of tetragonal zirconia polycrystals (TZP)

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Surface modification technologies are available for tetragonal zirconia polycrystal (TZP) to enhance its osseointegration and fibro-integration capability for biomedical fields. The surface wettability is one of the important factors in the process of osseointegration and fibro-integration, possibly regulating protein adsorption, and subsequent cell behavior. The aim of this study was to clarify the effect of topographical or physicochemical modification of TZP ceramics on wettability to determine the potential of such treatment in application to dental implants. Several types of surface topography were produced by alumina blasting and acid etching with hydrofluoric acid; surface physicochemistry was modified with oxygen (O2) plasma, ultraviolet (UV) irradiation, or hydrogen peroxide treatment. The obtained specimens were also subjected to storage under various conditions to evaluate their potential to maintain superhydrophilicity. The surface wettability was evaluated by measuring the contact angle against distilled water. The modified surfaces were also analyzed using an X-ray photoelectron spectroscopy (XPS). The results showed that surface modification of surface topography or physicochemistry, especially of blast/acid etching as well as O2 plasma and UV treatment, greatly increased the surface wettability, resulting in superhydrophilicity. XPS analyses revealed that a remarkable decrease in carbon content and the introduction of hydroxyl groups were responsible for the observed superhydrophilicity. Furthermore, superhydrophilicity was maintained, even after immersion in an aqueous solution. These results indicated that topographical and physicochemical modification with O2 plasma and UV treatment to TZP and subsequent immersion in aqueous solution is promising methods for creating superhydrophilicity, leading to important factors in osseointegration and fibro-integration for dental implants.

Recent Publications:

1. Sakurai T, Yoshinari M, Toyama T, Hayakawa T, Ohkubo C (2016) Effects of a multilayered DNA/protamine coating on titanium implants on bone responses. J Biomed Mater Res Part A 104A: 1500–1509.
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Biography

Masao Yoshinari earned his Ph.D. in Dental Materials Science in 1986 from Tokyo Dental College. He is the director of Division of Oral Implants Research, Oral Health Science Center, Tokyo Dental College. He has published more than 200 articles in reputed journals and book chapters including surface modifications of titanium for implant use, fatigue properties of ceramics, and corrosion characteristics of dental alloys.

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