Ministry of Higher Education and Scientific Research
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College of Dentistry

PREPARATION AND EVALUATION OF A NOVEL NATURAL RICE HUSK-DERIVED SILICA AND EGGSHELL-DERIVED CALCIUM CARBONATE COMPOSITE COATING ON ZIRCONIA IMPLANT SCREWS

A Thesis
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ABSTRACT

Background: Implant dentistry is unique modality of treatment due to its capability of achieving the purpose of restoring function irrespective to the atrophy, diseases, or injury of the stomatognathic system. Despite of huge advances in the implant dentistry, much more still available for continued progress. Zirconia implants have been recommended for highly demanding esthetic circumstances primarily involving the anterior maxillary zone, for areas with compromised soft tissue, and for patients who suffer from metal sensitivity. However, zirconia implants may have been introduced without sufficient validation of their adoption as equivalent to or better than titanium implants. This study aimed to prepare and characterize a $CaCO_3$-SiO_2 bioactive composite derived from natural sustained raw materials to be used as a coating for zirconia dental implant.

Materials and methods: for invitro disc-shaped specimens with a diameter of 10 mm and thickness of 2 mm were prepared from partially sintered Yttria-stabilized tetragonal zirconia polycrystal. The natural prepared composite was deposited via radiofrequency reactive magnetron sputtering. The experimental specimens were characterized by x-ray diffraction, field emission scanning electron microscope, energy dispersive spectroscopy, x-ray fluorescence optical microscope and atomic force microscope. In the pilot study, pull-off test was accomplished in order to assess strength of adhesion between zirconia substrate and the experimental coating materials. Based on the results of Pull-off test, the concentration ratios of the coating composite were demarcated. In vitro characterization included cytotoxicity, wettability, surface roughness, Xray diffraction, Xray fluorescence, energy dispersive spectroscopy, atomic force microscope and scanning electron microscope. While for in vivo studies, ninety zirconia screws have been divided into two groups; Forty-five screws for two weeks

healing interval and other forty-five screws for six weeks healing interval. For each interval 30 screws were used for mechanical torque removal test which were further subdivided into three groups; 10 screws as a negative control, 10 screws as a positive control, and the last 10 screws as an experimental group. While the other 15 screws were utilized for histological test. They were also subdivided into three groups 5 screws for each; negative control, positive control and experimental groups. *In vivo* investigations include removal torque, histomorphometry and soft tissue compatibility tests.

Results: The results achieved from characterization data verified the chemical composition of the prepared powders and their ratios within the prepared composite. Physical tests results demonstrated significant improvement in the wettability and surface roughness after coating with naturally prepared $CaCO_3/SiO_2$ composite, at the same time *in vitro* assessments proved it's biocompatibility. While *in vivo* investigations indicated an increase in torque removal and bone formation. The soft tissue compatibility exhibited that there is no inflammatory response for the natural composite.

Conclusion: The naturally prepared $CaCO_3/SiO_2$ composite exhibits more hydrophilicity with an improvement in the adhesion force to the zirconia substrate in comparison to the artificial $CaCO_3/SiO_2$ composite. Therefore, it is recommended to be used as coating material for zirconia implants with promising biological and mechanical properties.

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تحضير وتقييم الخليط الطبيعي من مادتي السيليكا المشتقة من قشور الرز, وكاربونات الكالسيوم المشتقة من قشور البيض كطلاء لزرعات الزركونيا.

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