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Biocompatibility and antibiofilm activity of graphene-oxide functionalized titanium discs and collagen membranes

LABORATORY TESTS

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ABSTRACT

In order to prevent the most frequent complications such as peri-mucositis and periimplantitis and consequently improve the clinical results of GBR procedures, such as regaining sufficient bone and reducing bacterial infection, there is a need not only to improve dental implant macro and micro topography but also to improve antimicrobial characteristics of barrier membranes. The biocompatibility and antimicrobial characteristics of materials can be improved by changing the topography and the chemical composition of the implant surface by coating it with bioactive molecules, such as graphene oxide (GO). This study aimed to evaluate the effect on biofilm formation of barrier membranes and titanium surfaces coated with graphene-oxide (GO); analyze the connection between the superficial topography of the tested materials and the amount of bacterial accumulation on them and analyze the biocompatibility of GO functionalized discs using the zebrafish model. The samples used for *in vitro* studies were obtained modifiyng the experimental cortical membranes (OsteoBiol® *Lamina*®, Tecnoss®, Giaveno Italy), cut into square pieces (5 × 5 × 2 mm), with graphene oxide (GO). Single species bacterial biofilms (*Streptococcus oralis, Veilonella parvula, Fusobacterium nucleatum, Porphyomonas gingivalis*) were grown on GO-free membranes, membranes coated with 2 and 10 μg/ml of GO, GO-free and GO-coated titanium discs. The biofilms were analyzed by determining the CFU count and by Scanning Electron Microscopy (SEM) and the materials' topography by Atomic Force Microscopy (AFM). The zebrafish model was used to determine the materials' toxicity and inflammatory effects. AFM showed similar roughness of control and GO-coated materials. CFU counts on GO-coated discs were significantly lower than on control discs for all species. CFU counts of *S. oralis, V. parvula,* and *P. gingivalis* were lower on biofilms grown on both types of GO-coated membranes than on GO-free membranes. SEM analysis showed different formations of single species biofilm of *S. oralis* on control and GO-coated materials. GO-functionalized titanium discs do not induce toxic or inflammatory effects.

CONCLUSIONS

As both the membranes and titanium discs coated with GO showed an antibiofilm effect in vitro on all the tested bacterial species, the Authors concluded that the present study is *"particularly promising because GO-coated materials demonstrate to be safe for early and late zebrafish embryo development and effective in inhibiting microbial proliferation in vitro. These results encourage further in vivo investigation of GO functionalized materials in the reduction of the incidence of peri-implant mucositis and periimplantitis"*.

ORIGINAL ARTICLE
Dental Materials
2022 Jul;38(7):1117-1127

Material tested

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Abstract author: Cristina Rodighiero, dental journalist, free publication, not for resale. Printed by Tecnoss® Dental s.r.l.

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