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Antibacterial effects of bio-inspired nanostructured materials

Monika Astasov-Frauenhoffer[a], Khaled Mukaddam[b], Irmgard Hauser-Gerspach[a], Joachim Köser[c], Thilo Glatzel[d], Marcin Kisiel[d], Laurent Marot[d] and Sebastian Kühl[b]

[a]Department of Preventive Dentistry and Oral Microbiology, University Center for Dental Medicine, University of Basel, Basel, Switzerland; [b]Department of Oral Surgery, Oral Radiology and Oral Medicine, University Center for Dental Medicine, University of Basel, Basel, Switzerland; [c]Institut für Chemie und Bioanalytik, Hochschule für Life Sciences, Muttenz, Switzerland; [d]Department of Physics, University of Basel, Basel, Switzerland

ABSTRACT

Several properties of bio-inspired surfaces like chemical composition, surface topography, surface hydrophilicity and even surface charge could influence bacterial adhesion to implant materials. Therefore, a nanostructured surface is being investigated to avoid bacterial colonization by their physico-mechanical and chemical aspects.

Both smooth and rough-surfaced titanium (PT, SLA) and zirconia (M and ZLA) surfaces were used as controls. Titanium SLA was modified by two-step-etching to create nanostructured surface. Antibacterial properties of the materials were tested by adhesion of *Porphyromonas gingivalis* (ATCC 33277). The vitality of bacteria was assessed by Live/Dead BacLight™ Bacterial Viability Kit or by conventional culturing on Columbia blood agar.

Conventional culturing revealed reduction of bacteria on nanostructured titanium ($5.27\pm0.8 \times 10^4$ CFU/mm^2) in comparison to rough-surfaced control materials (ZLA $6.16 \pm4.86 \times 10^4$ and SLA $1.53\pm0.75 \times 10^5$ CFU/mm^2). However, smooth-surfaced control materials (M $2.25\pm0.84 \times 10^4$ and PT $6.63\pm5.77 \times 10^3$ CFU/mm^2) showed similar results to the nanostructured material. Live/dead staining demonstrated the antimicrobial efficacy of the nanostructured material revealing reduction of vital bacteria population up to 70%. This effect was not observed on the control materials (bacterial vitality ≥95%).

In conclusion, nanostructured titanium surface shows a reduction of vital bacteria. Therefore, bio-inspired nanostructures can modify the bacteria–titanium interaction.

CONTACT Monika Astasov-Frauenhoffer m.astasov-frauenhoffer@unibas.ch