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In vivo assessment of oral biofilm: Gold titanate interactions

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Antimicrobial activity of gold nanoparticles (NPs) against several bacteria has recently been explored. Titanates have been used as an ion exchanger binding to various metal ions and can act as a carrier. In this study, we investigated antibacterial activities of titanates and gold-titanates *in vivo*. The process to fabricate the various titanates was described in US patent #8,545,820. This is the first *in vivo* study of gold titanateon cariogenic biofilm. After giving consent, ten healthy volunteers were recruited to wear palatal appliances containing a bonded enam el/dentin block. The present study has a crossover design of three phases.The subjects were randomly assigned to the following treatment groups of negative control, bonding agent only; (2) active control, bonding agent with titanates only, and the experimental group, bonding agent with gold-titanates complex. The blocks were secured to a palatal appliance custom made for each subject and harvested at the end of 1 week. There was a 1-week rest period before the next treatment group. Once extracted the palatal implants were split into two separate samples; one for bacterial culture and the other for fluorescent staining and imaging. Samples destined for culture were sonicated in a pre-reduced transport media (1xPBS), serially diluted, and plated on species-selective media for colony forming unit (CFU) quantitation. Samplesmeant for whole biofilm imaging were fixed and tagged with fluorescently conjugated, species-specific antibodies then imaged using a Zeiss LSM 510 laser confocal scanningmicroscope (LCSM). The spatial-temporal distribution of the bacteria within the biofilms for each sample was analyzed in conjunction with their respective CFU counts. Results of the *in vivo* assessment of a bonded enamel/dentin block yielded antimicrobial efficacy primarily in the experimental group. The principle-colonizers Streptococcus *mutan*s and Streptococcus gordonii as well as *Lactobacillus casei*, were the species shown to be most inhibited by the presence of the titanate complex. The late-colonizing, strict anaerobic species Fusobacterium nucleatum and Porphyromonas gingivalis were still present though in reduced numbers within the experimental group. The control groups both demonstrated increased CFU counts for all bacterial groups as well as expected spatial-temporal distribution of species within stained whole biofilms, though; the active control held moderate antimicrobial efficacy similar to that seen in the experimental group. LCSM images from whole biofilms from the experimental group show decreased S. mutans and S. gordonii adherence to the sample surface while controls largely demonstrate principle colonization of both these species and further adherence of *F. nucleatum* and P. *gingivalis*, which is characteristic of oral biofilms. Though the titantate complex did not yield significant anti-microbial activity directly against the anaerobic late-colonizers, their accumulation was still hindered by the absence of the principle-colonizers. These results support further development of gold-titanatesas potential novel materials to prevent dental caries.

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New developments in atomic resolution holography

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Atomic resolution neutron holography (ARNH) constitutes a novel technique to obtain structural information in three dimensions of the local crystal structure. It is based on the recording of the interference of neutron waves coherently scattered by nuclei located on a crystal lattice with a suitable reference wave. Technically the method restricted to the systems containing isotopes possessing either high absorption, or high incoherent scattering cross section. In the present talk we discuss the ways of carrying out successful observation of ARNH. At present time the ARNH is demonstrated only for five systems. The main practical information gained from ARHN is the observation of local distortion of the crystal structure around the impurities up to fifth-sixth neighbours. The way of extension of the method for polycrystalline sample is also discussed. The application of the ARNH is demonstrated by experimental results.

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