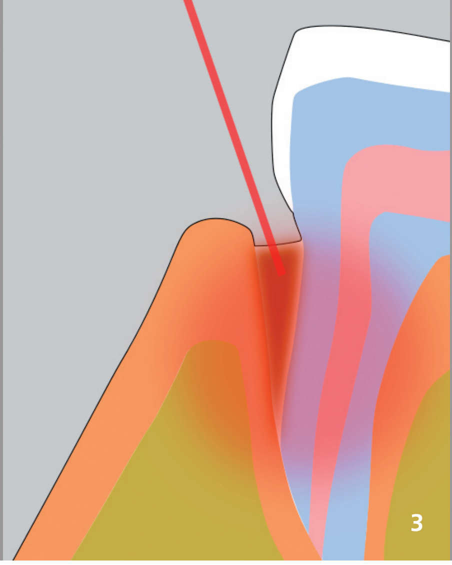

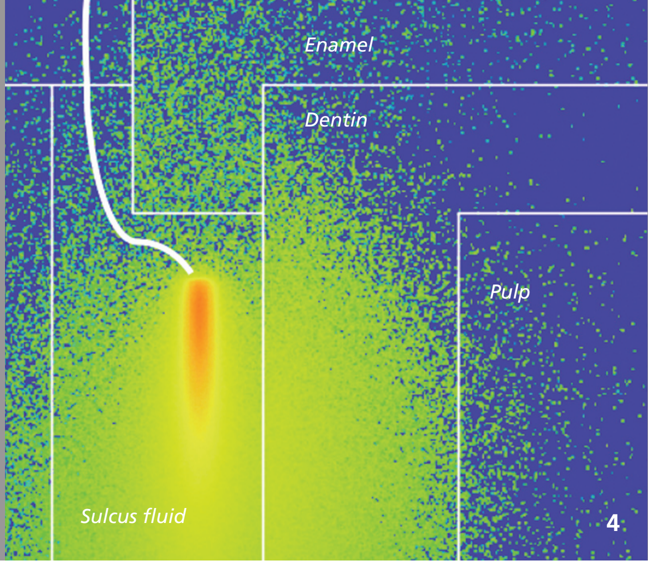

MODELING ANTIMICROBIAL PHOTODYNAMIC THERAPY

Task

Antimicrobial photodynamic therapy (aPDT) is used in minor cases of periodontitis and as a supplement to conventional mechanical or anti-infective treatment methods. Its full potential is not currently being exploited due to a lack of knowledge of the physical and chemical processes involved in aPDT. This work aims to extend empirical clinical research methods to cover mathematical-physical modeling, which will augment the understanding of aPDT.

Method

A phenomenology of the active principle of laser-induced aPDT is set out in the literature: the organisms responsible for disease progression are destroyed as a consequence of a biochemical reaction when a photoactive agent is inserted into the inflected area and irradiated by laser radiation with a low output power in the mW region. The concentrations of the substances involved in the aPDT are described in rate equations in a spatially homogeneous model familiar from tumor therapy. The success of the therapy is calculated by resolving these equations and predicted as a function of the treatment parameters and initial concentrations. The local intensity of the laser radiation in the periodontium is one of the input variables for the rate equations and is simulated beforehand as a spatial distributed variable.

Result

Early results allow conclusions to be drawn about the initial concentrations of the substances involved. These initial concentrations have to be present at the start of treatment so that the therapy can be completed successfully. The structure of the rate equations also motivates a separation of the time scales on which the therapy processes run. This separation of time scales provides a method for controlling and observing the ongoing processes during the therapy.

Applications

The long-term goal of model-based therapy is being pursued with the aid of the aforementioned investigations. In addition to periodontal treatment, tumor therapy and dermatological treatments constitute other compelling applications.

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3 Schematic of the periodontium.
4 Simulated intensity distribution in the periodontal model.