Fluorescence microscopy and spectroscopy as tools for rapid bacterial detection and assessment of disinfection techniques in clinical settings

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With increasing information on the involvement of resistant biofilms in a large proportion of persistent infections, more focus is being given to the development of appropriate disinfection methods and the detection of residual bioburden. In dental root canal treatments approximately 24% require secondary treatment due to persistence of biofilms in the root canal space [1]. Similarly, dental implant failures related to microbial resistance occur in 17% of cases and lead to complications in over 50% [2].

Here, we demonstrate fluorescence-based chair-side detection of biofilms during and after root canal treatments. Live fluorescent staining with calcein AM followed by spectral analysis has shown to be a clinically viable method for detection within 5 minutes [3]. 1-year follow ups of treated patients highlight the clinical relevance of bacterial detection post-treatment.

In addition, we show how fluorescence microscopy and spectroscopy can be applied as tools to assess disinfection methods *in-vitro* in a rapid and user-friendly manner. A *P. gingivalis* biofilm model was used to assess a number of disinfection methods. Comparison of culturing and optical detection methods, such as optical coherence tomography, was carried out. Fluorescence staining combined with microscopy and spectroscopy was shown to be a rapid method for the reliable detection of residual stressed vital biofilm bacteria, whereas commonly used culture methods can often produce a false negative result (Figure 1).

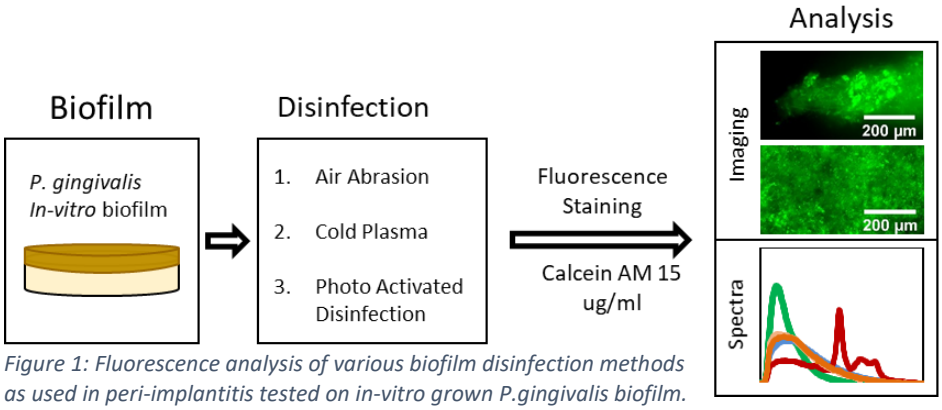

Figure 1: Fluorescence analysis of various biofilm disinfection methods as used in peri-implantitis tested on in-vitro grown P.gingivalis biofilm.

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[2] P. Simonis, T. Dufour, H. Tenenbaum, Long-term implant survival and success: a 10-16-year follow-up of non-submerged dental implants., Clin. Oral Implants Res. 21 (2010) 772–7. doi:10.1111/j.1600-0501.2010.01912.x.

[3] D.B. Herzog, N.A. Hosny, S.A. Niazi, G. Koller, R.J. Cook, F. Foschi, T.F. Watson, F. Mannocci, F. Festy, Rapid Bacterial Detection during Endodontic Treatment, J. Dent. Res. (2017) 2203451769172. doi:10.1177/0022034517691723.