The susceptibility of E. faecalis biofilm against selected new quaternary ammonium compounds

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Introduction: An increasing microbial resistance to known antibiotics raises the demand for new antimicrobials. New antibacterial agent should have a good activity against planktonic as well as biofilm bacteria. Quaternary ammonium compounds (QACs), are widely used in medicine, have proven antimicrobial properties, and are low toxic and low irritating. In this study new QACs were evaluated for their biofilm eradication efficiency as antibacterial compounds and as irrigants in combination with Er:YAG photoacoustic streaming.

Aims: To evaluate the effectiveness of new QACs against E. faecalis biofilms and to increase the effectiveness of QACs with laser treatment.

Method: The biofilm of E. faecalis were grown on titanium surface. The fraction of the dead cells and the biofilm surface coverage was determined with LIVE/DEAD\textsuperscript{TM} using confocal microscopy (CLSM) before and after QACs treatment. To enhance the effectiveness the biofilm samples were pretreated with QACs followed by short laser Er:YAG photoacoustic streaming treatment.

Results: All tested QACs were effective against the E. faecalis biofilms. The best anti-biofilm compounds were N-Alkylimidazolinium derivatives. Compared to planktonic bacteria the bacteria in the biofilm were up to 10 fold more resistant. The fraction of the dead bacteria that were treated with QACs followed by Er:YAG photoacoustic streaming increased significantly compared to the chemical treatment alone. In addition, the biofilm surface coverage decreased after laser treatment.

Conclusions: The results suggest that new QACs have a great potential as antibacterial compounds effective against biofilms of E. faecalis. The laser treatment can significantly improve the effectiveness of QACs treatment.