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Dentistry Under a New Light: Antimicrobial Photodynamic Therapy as Sustainable Solution for Periodontitis and Periimplantitis Treatment

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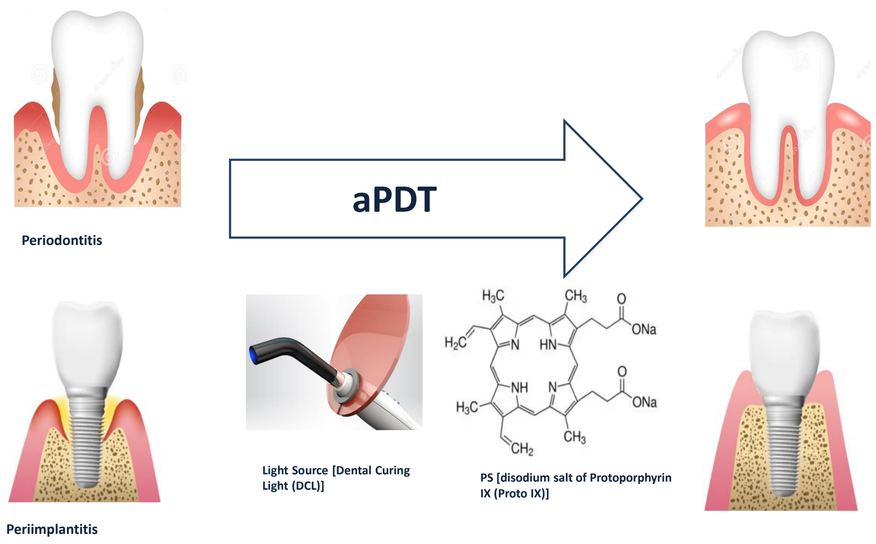
Introduction

Oral health conditions can significantly impact on the quality of life. Despite the scientific progress in the understanding of the pathogenesis and oral diseases causes, these are a global public health. Poor oral health results in pain, substandard nutrition, work absence and lowered self-esteem. Chronic oral infection is a proven risk factor for diabetes, heart, and lung disease. (1)

Periodontitis and periimplantitis are oral conditions that have an infection etiology.(2) Despite of the current available techniques used for these diseases' treatment, none guaranties the total eradication neither prevent (re)infection. It is urgent to find alternative treatments to mitigate these difficulties and improve the diseases' prognosis.

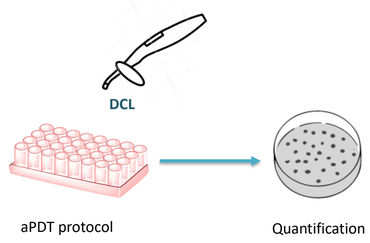


Antimicrobial Photodynamic Therapy (aPDT) arises as an alternative with unique features and presents advantages when compared the use of conventional antimicrobials, showing to be efficient and preventing the development of resistance. (3) aPDT has been extensively studied to treat periimplantitis and periodontitis, but the developed protocols are restricted to phenothiazinium photosensitizers, such as methylene blue, and to the use of red lasers as light source. (4)

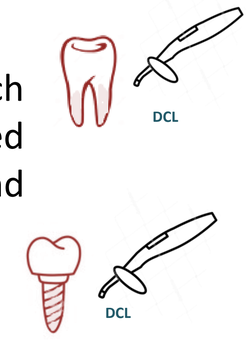
It is intended to develop an effective therapeutic approach to treat periimplantitis and periodontitis based on aPDT using porphyrins already approved for clinical and the dental curing light (DCL-available in all dental clinics) as light source.

Methods

- The *in vitro* photoinactivation assays of periodontopathogens (*E. faecalis* and *C. albicans*) were carried out in PBS, with different concentrations of Proto IX as photosensitizer and DCL as a light source.

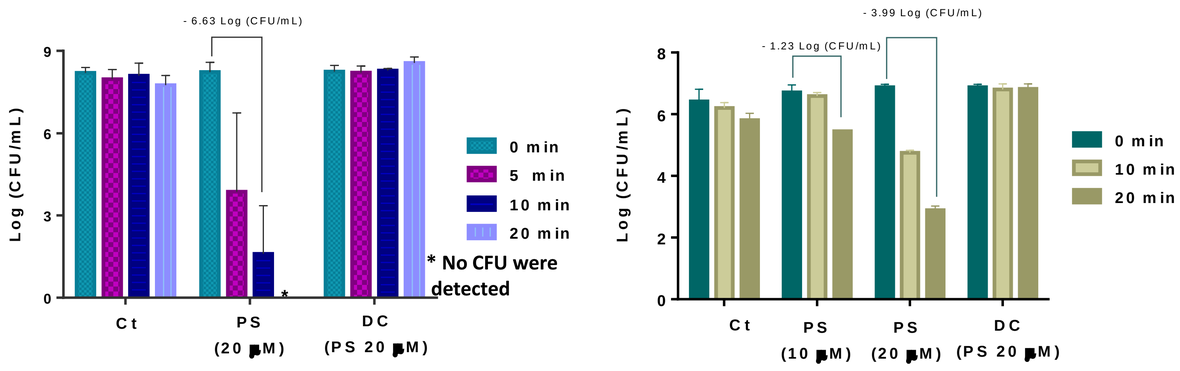


- The ex vivo antimicrobial inactivation of such periodontopathogens were also evaluated under the same aPDT protocol in teeth and dental implants.



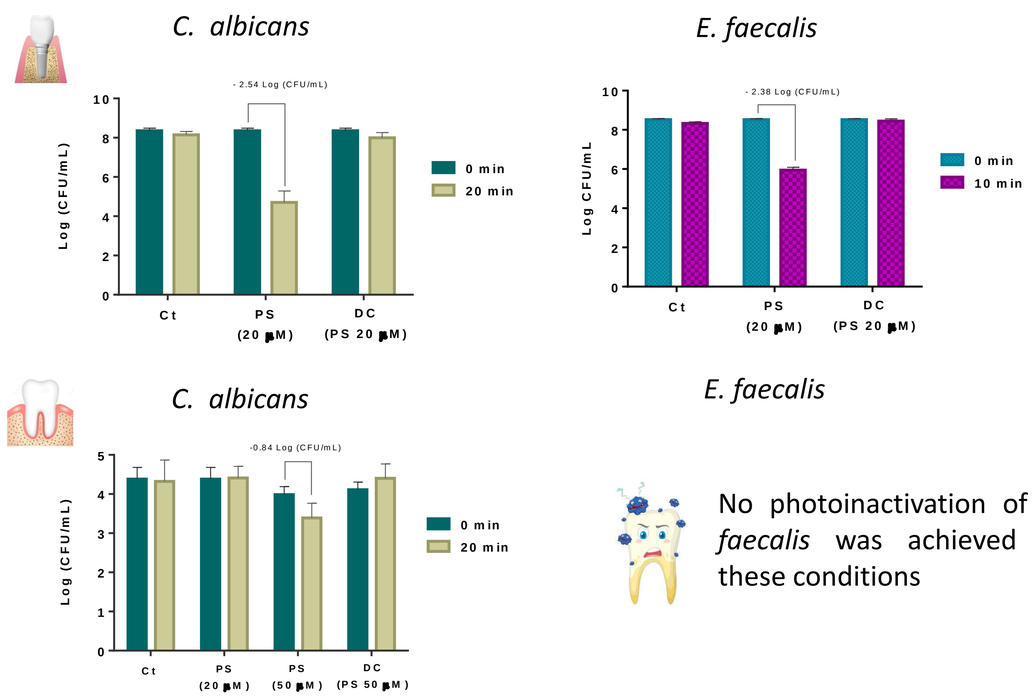
Results

In vitro assays



- ✓ *In vitro* assays showed an effective photoinactivation of the periodontopathogens when exposed to different concentrations of Proto IX and irradiated with DCL.
- ✓ *E. faecalis* survival suffered a decrease of 6.94 log CFU mL^{-1} after 10 min of irradiation and after 20 min of irradiation no bacteria were detected.
- ✓ For *C. albicans,* a decrease of ~ 2 log CFU mL^{-1} in the concentration of the fungus was observed after 10 min of irradiation, and a decrease of ~4 log CFU mL^{-1} after 20 minutes of DCL irradiation.

Ex vivo assays



No photoinactivation of *E. faecalis* was achieved at these conditions

- ✓ *Ex vivo* assays in dental implants showed promising results, with high photoinactivations rates of *E. faecalis* and *C. albicans*.
- ✓ However, probably due to the complex tooth matrix, the aPDT efficiency in the photoinactivation of *C. albicans* and *E. faecalis* teeth was modest.

Conclusion

The aPDT protocol achieved by the combination of Proto IX and DCL showed to be efficient in the inactivation of periodontopathogens. Further studies must be carried on improving the aPDT efficiency in teeth. These results opens new perspectives for an efficient aPDT protocol development to treat periodontitis and periimplantitis that can be easily implemented in all dental clinics and available to entire population, contributing to the democratization of medical services.

References

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Ethical declaration

The use of these teeth for research was approved by the Comissão de Ética para a Saúde of the Universidade Católica Portuguesa (project CES160 - - Evaluation of new materials and/or compounds with antimicrobial activity and of new methodologies for intracanal disinfection in endodontics: *an ex vivo* model).

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