Introduction

Periodontal diseases are one of the major causes of tooth loss in adults and is considered primarily an anaerobic bacterial infection caused by the so-called red complex species. Bacteria present in a biofilm community. Enzymes, endotoxins, and other cytotoxic factors from these bacteria lead to tissue destruction and initiate chronic inflammation.

The current treatment regimen involves mechanical debridement and this may be augmented with antibiotic therapy. Antimicrobial agents used systemically or as a local drug delivery further suppress the periodontal pathogens increasing the benefits of conventional mechanical therapy. However, the emergence of resistant microorganisms and a shift in the microflora after extended use, limits the use of antimicrobials. Other approaches to the local delivery of antimicrobial agents were investigated, including the use of photodynamic therapy (PDT). Since the 1890s, scientists used the staining properties of dyes to develop the idea of selective toxicity. This created the foundation for our modern use of chemotherapy. The application of light and dyes to destroy microbial species in vitro has been reported for many years.

Photodynamic Therapy

It is the light induced non-thermal inactivation of cells, microorganisms or molecules.

Light Sources

- A blue or visible light source is used to activate the photosensitizer.
- Diod laser system & light-emitting diods are used.
- Photosensitizers can also be activated by low power visible light at a specific wavelength.
- Light must penetrate as far as possible into the tissues and not produce thermal effects.

Light Sources Now

- Wave-length matched to photosensitizer
- Safe & non-damage to host tissue
- Portable
- Non-thermal diod laser
- Advanced fiberoptics

Light Sources

1. Dye molecules adapt to the bacteria membrane
2. Laser light activates dye molecules
3. Reaction with oxygen leads to the killing of bacteria
4. Aggressive singlet oxygen oxidizes the membrane of the bacterium

Photsensitizer in Periodontal Therapy

- Ideally should be: non-toxic & activated upon illumination
- Should bind with bacteria & plaque without causing any cosmetic issues, such as unwanted staining of gingiva & other soft tissues
- Easily access pathogens present in deeper periodontal pockets

Dyes: 1. Tricyclic dyes (methylene blue, toludine blue O & acridine orange) 2. Porphyrines (aluminum disulfonated phthalo-cyanine and cationic Zn(II) phthalocyanine)
- Chlorines: chlorine e6, stannous (IV) chlorides, chlorine e6-2.5 N-methyl-4-guanine (BLCl0101), polylysine & polyethyleneimine conjugates of chlorine e6
- Phophyrines: haematoporphyrin HCl, photofrin and 5- minolevulinic acid (ALA), benzoporphyrin derivative (BPD)
- Xanthenes: Erythrosine
- Monoparane: azulene

Photosensitizer in Periodontal Therapy

Various in-vitro studies have shown that periodontal micro-organisms are killed more than 4–5 times at micromolar concentration after incubation times as short as 5–10 minutes and irradiation under mild experimental conditions, such as fluence rates around 50 mW/cm² and irradiation times shorter than 15 minutes

Conclusions & Suggestions

- This new strategy of using PDT is less traumatic & quicker in the treatment of inflammatory periodontal diseases
- Photodynamic therapy in vitro studies have shown greater (>95%) reduction in micro-organisms.
- PDT offers numerous advantages, particularly in avoiding emergence of antibiotic resistance species, requiring less technical skills & reducing operating time in comparison to manual scaling and root planing.
- Well-designed clinical trials are needed for proper evaluation of this therapy.
- Multi-disciplinary clinical trials should be designed to establish the clinical evidence based effectiveness of PDT in periodontal, endodontics and even orthodontic treatment.