Introduction:
Periodontal diseases result from accumulation of bacterial biofilms on tooth surfaces. The mechanical removal of the biofilm and adjunctive use of antibacterial disinfectants or various antibiotics have been conventional methods of the periodontal therapy. Recently there have been a number of reports about the bacterial strains becoming resistant particularly due to the frequent use of antibiotics. As the scientific community is seeking alternatives to antibiotic treatment, periodontal researchers found that photodynamic therapy (PDT) is advantageous for suppressing anaerobic bacteria that lead to periodontal diseases (Pitzner et al 2004). The German physician Friedrich Meyer-Betz performed the pioneering study which was at first called photo radiation therapy (PRT) with porphyrins in 1913. PDT was first approved by the Food and Drug Administration in 1999 to treat precancerous skin lesions of the face or scalp. John Toth renamed the therapy as Photodynamic therapy (PDT). Therefore the aim of this review was to describe in detail application of photodynamic therapy in periodontal therapy.

Principle of PDT:
PDT is based on the principle that a photo-activatable substance (the photosensitizer) binds to the target cell and can be activated by light of a suitable wavelength. During this process, free radicals are formed (among them singlet oxygen), which then produce an effect that is toxic to the cell. To have a specific toxic effect on bacterial cells, the respective photosensitizer needs to have selectivity for prokaryotic cells.

Mechanism of action:
PDT involves two stages. In the first stage, a light-sensitive drug is applied. The second stage involves shining a light or laser directly on the area treated with the drug. When the light is combined with the drug, phototoxic reactions are induced which destroy bacterial cells. Briefly, upon illumination, the photosensitizer is excited from the ground state to the triplet state. The longer life time of the triplet state enables the interaction of the excited photosensitizer with the surrounding molecules. The generation of the cytotoxic species takes place during PDT while in this state only. The cytotoxic product, usually 1O2 cannot migrate >0.02 mm after its formation, thus making it ideal for the local application of PDT without endangering distant molecules, cells, or organs.

Photosensitizers:
Various studies of use of PDT along with SRP in treatment of periodontal disease have been performed the pioneering study which was at first called photo radiation therapy (PRT) with porphyrins in 1913. PDT was first approved by the Food and Drug Administration in 1999 to treat precancerous skin lesions of the face or scalp. John Toth renamed the therapy as Photodynamic therapy (PDT). Therefore the aim of this review was to describe in detail application of photodynamic therapy in periodontal therapy.

Applications of PDT in Periodontics

1. Non-surgical treatment of aggressive periodontitis:
de Oliveira et al (2007) stated that 10 patients with aggressive periodontitis treated with PDT using a laser source with a wavelength of 690 nm associated with a phenothiazine photosensitizer or scaling and root planning (SRP), at 3 months PDT results were comparable to SRP alone.

2. An adjunct in non surgical periodontal treatment:
Various studies of use of PDT along with SRP in treatment of chronic periodontitis failed to result in an additional improvement in terms of pocket depth reduction and CAL gain, but it resulted in a significantly higher reduction in bleeding scores compared to scaling and root planning alone.

3. Destruction of periodontopathogenic bacteria:
Various studies have shown that Gram-positive bacteria are most susceptible to PDT. Photo-killing of Gram negative bacteria is also possible. However, experiments were published showing PDT resistant Gram-negative bacteria. Resistance to the light action, are mostly the consequence of poor cellular uptake of the sensitizer.

4. Effect on periodontal bone loss in furcations:
A study evaluated the influence of PDT on bone loss in furcation areas in rats with experimentally – induced periodontal disease and concluded that PDT may be an effective alternative for control of bone loss in furcation areas in periodontitis (de Almeida et al 2008).

Conclusion:
PDT application has an adjunctive benefit besides mechanical...
treatment at sites with difficult access (e.g. furcations, deep invaginations, concavities). Necessity for flap operations may be reduced, patient comfort may increase and treatment time decrease. PDT removes the biofilm in residual deep pockets during maintenance; no more root substance is removed by mechanical retreatment. Even after such a detailed knowledge and published data there is no routine application of PDT in periodontal diseases as well as in general practice because of no controlled studies proving superior effect than traditional SRP with or without antimicrobials. Therefore, the concept of PDT is plausible and could foster new therapy concepts for periodontal disease. The available knowledge should enable and encourage steps forward into more clinical oriented research and development.

References: