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Light activated antimicrobial agents

Photodynamic Therapy: Light Activated Antimicrobial Agents

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Authors:
Post graduate student Dr Saurabh Lall, Reader Dr Srinivas Sulugodu Ramachandra, Prof. Dr. Jithendra K. D., HOD
Kanti Devi Dental College and Hospital, Department of Periodontics, Uttar Pradesh, India

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Introduction

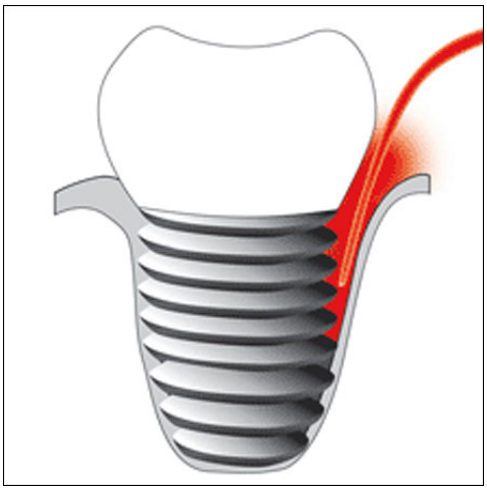
Photodynamic therapy (PDT) can be defined as eradication of target cells by reactive oxygen species produced by means of a photosensitizing compound and light of an appropriate wavelength.

History of PDT:

Raab in 1900 introduced the concept of photodynamic therapy
In 1982, John Toth published first scientific paper on photodynamic therapy.
In 1986, T Dougherty formed the "International Photodynamic Association".

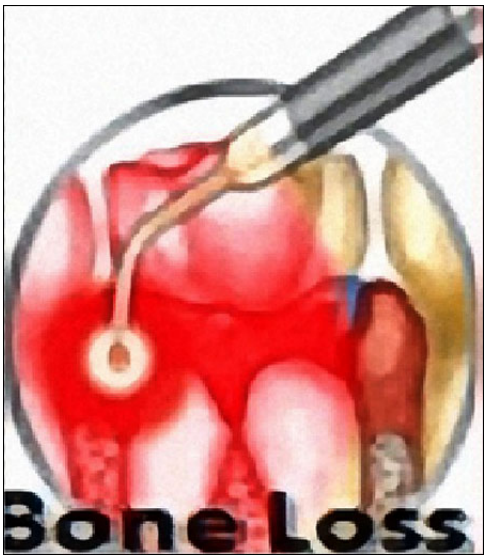
Applications

In dentistry photodynamic therapy has various applications: it can be used in the treatment of periodontitis, peri-implantitis, to sterilize root canals during endodontic therapy.



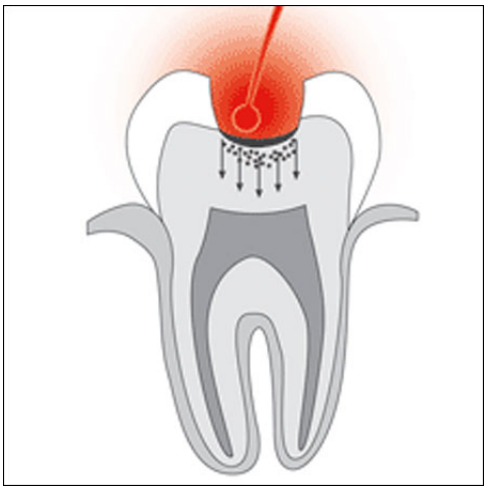
Applications of PDT: Implants

Applications of PDT: Periodontal Pockets



Applications of PDT: Bone Loss

Applications of PDT: Root Canal Therapy



Applications of PDT: Caries

Photosensitisers

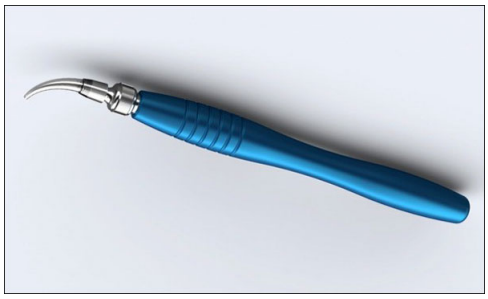
PDT uses several photoactive components. An ideal photosensitizer should be non-toxic and activated upon illumination.

Various drugs are used as photoactive components:

1. Phenothiazine dyes: methylene blue, toludine blue O and acridine orange
2. Phthalocyanines - aluminum disulphonated phthalocyanine and cationic Zn(II)-phthalocyanine.
3. Chlorines: chlorine e6, stannous (IV) chlorine e6, chlorine e6-2.5 N-methyl-d-glucamine (BLC1010), polylysine and polyethyleneimine conjugates of chlorine e6.
4. Porphyrines: haematoporphyrin HCl, photofrin and 5-aminolevulinic acid (ALA), benzoporphyrin derivative (BPD).
5. Xanthenes: erythrosine.

Phenothiazine Dyes	Methylene Blue Toluidine Blue O
Phthalocyanines	Aluminum disulfonated phthalocyanine Cationic Zn(II)-phthalocyanine
Chlorines	Chlorin e6 Sn(IV)chlorin e6 Chlorin e6-2.5 *N*-methyl-D-glucamine Polylysine and polyethyleneimine conjugates of chlorin e6
Porphyrins	Hematoporphyrin HCl Aminolevulinic acid Photofrin (dihematoporphyrin ether)
Xanthenes	Erythrosine
Monoterpenes	Azulene

Photosensitisers used in PDT

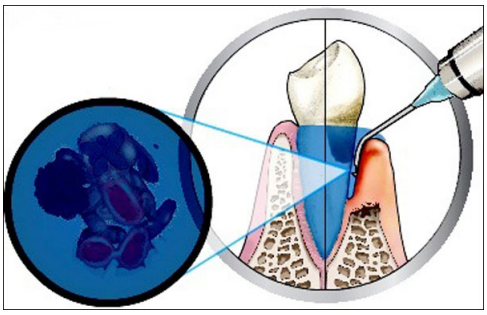


PDT Handpiece

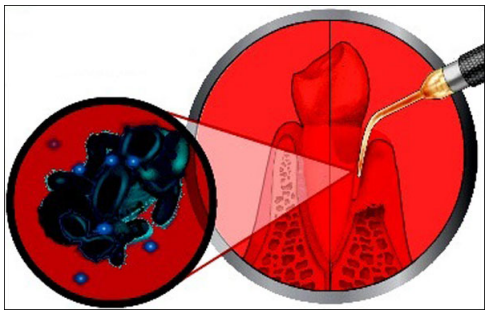
PDT Device

Sequence of events in photodynamic therapy for treatment of periodontal disease

Step 1: A photosensitive drug is delivered into the periodontal pocket.
Step 2: Target area or the periodontal pocket is exposed to light usually laser light.



Procedure: Step 1 of PDT



Procedure: Step 2 of PDT

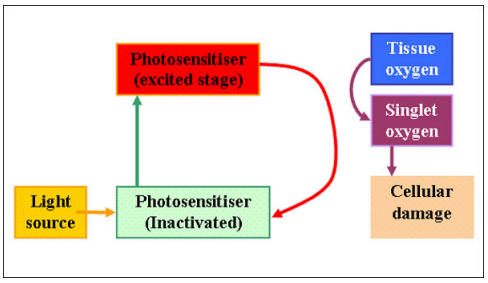
Mechanism of action of PDT or Principle of PDT

Photosensitizer (PS) upon irradiation with light at appropriate wavelength undergoes transition into singlet and triplet state. It reacts with endogenous oxygen to form reactive species and highly reactive species causing cell death.

Advantages:

1. PDT is non-invasive local therapy,
2. PDT offers thorough irrigation and elimination of pathogens in inaccessible areas of periodontal pocket within short span of time, thus beneficial to both operator and the patient.
3. The risk of bacteraemia after periodontal debridement can be minimized.
4. There is no need to prescribe antibiotics, therefore the possibilty of side effects is avoided.

5. There is no need to anaesthetize the area and destruction of bacteria is achieved in a very short period (<,60 seconds).



Principle of PDT

Conclusion:

PDT application has an adjunctive benefit besides mechanical treatment at sites with difficult access. Necessity for flap operations may be reduced, patient comfort may increase and treatment time would decrease.

Literature

1. Malik R, Manocha A, Suresh DK. Photodynamic therapy--a strategic review. Indian J Dent Res. 2010;21(2):285-91.
2. Raghavendra M, Koregol A, Bhola S. Photodynamic therapy: a targeted therapy in periodontics. Aust Dent J. 2009;54 Suppl 1:S102-9.
3. Fontana et al. The antibacterial effect of photodynamic therapy in dental plaque-derived biofilms. J Periodontal Res. 2009;44(6):751-9.

Abbreviations

PDT: Photodynamic therapy
ALA: aminolevulinic acid
BPD: Benzoporphyrin derivative
PS: Photosensitizer

This Poster was submitted by Dr Saurabh Lall.

Correspondence address:
Dr Saurabh Lall
Kanti Devi Dental College and Hospital, Department of Periodontics
Delhi-Agra National Highway # 2
Uttar Pradesh
India

Poster Faksimile: