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Review Article

PHOTOACTIVATED DISINFECTION: A REVIEW

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A B S T R A C T

To promote root canal disinfection and debris removal and improve successful treatment we need effective irrigating solutions and proper instrumentations.The effective elimination of bacteria requires the initial cleaning of the canal by removal of the smear layer and the breakup of the biofilm leaving the bacteria accessible to the disinfecting agent .Materials which will remove the smear layer and or disturb the biofilm structure includes sodium hypochlorite ,EDTA, citric acid and photo activated disinfection process.

INTRODUCTION

Root canal treatment is based on cleaning, shaping and sealing the root canal system [1]: the main objectives are the complete dissolution of residual pulpal tissue,the elimination of bacteria from the root canals, and the prevention of recontamination after treatment [2-5].To increase efficacy of mechanical preparation and bacteria removal,instrumentation must be supplemented with active irrigating solutions.Irrigating solutions are considered to be essential for successful endodontic treatment [6-10]). Mechanical preparation cannot effectively eliminate bacteria from the root canal system [11, 12]. The objectives of irrigation are both mechanical and biologic[13]: the mechanical purpose involves flushing out debris,lubricating the canal and dissolving organic and inorganictissue; the biologic function is related to their antimicrobial effect.

A Photosensitizer is non-toxic dye(PS), and it is low intensity visible light which, in the presence of oxygen, combine to produce cytotoxic species. The principle on which it operates is thatPhotosensitizer moleculesattach to the membrane of the bacteria. Irradiation with light at a specific wavelength matched to the peak absorption of thePhotosensitizer leads to the production of singlet oxygen, which causes the bacterial cell wall to rupture, killing the bacteria [14, 15].Photosensitizer andlight source when used independently produce no effect on bacteria or on normal tissue; their combination alone has an effect on the pathogens [16,17].TBO is available in low, medium and high viscosities. Allsolutions have the same concentration of active ingredients. The PAD principle is not only effective against bacteria, but also against other micro-organisms including viruses, fungi and protozoa .Photosensitizerand a powerful red light are combined together in this treatment . The Photosensitizer is a watery solution of toluidine blue O (TBO) that attaches to the membranes of microorganisms and binds itself to their surface, absorbs energy from the light and then releases this energy to oxygen (O2), which is transformed into highly reactive oxygen species (ROS), such as oxygen ions and radicals. The reactive oxygen species reacts strongly and destroys the microorganismsinstantly and effectively.

How Photoactivated Disinfection Work

This method of disinfection used in both caries and endodontics has become available.Photosensitizer molecules attach to the membrane of the bacteria is the principle on which its working. Irradiation with light at a specific wavelength matched to the peak absorption of the photosensitizer leads to the production of singlet oxygen, which causes the bacterial cell wall to rupture killing the bacteria.

An important aspect of this system is that the two components when used independently of one another produce no effect on bacteria or on normal tissue. It is only the combination of photosensitizer and light which produces the effect on the bacteria.[18-20] for endodontic use consisting of a small diode laser connected to a delivery fibre, disposable hand piece and emitter.

This is used in conjunction with a 12.7mg/l solution of the photosensitizer, tolonium chloride. This is a pharmaceutical grade of the vital stain, Toluidene blue O. This system has been evaluated in the laboratory and bacterial kills of the order of 10^9 have been achieved under conditions comparable to those found clinically. The common bacteria associated with

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endodontic infections such as Fusobacteriumnucleatum, Prevotellaintermedia, Streptococcus intermedius and Peptostreptococcus micros. It has also been shown that the PAD system will kill Enterococcus faecalis which is regarded as one of the contaminants associated with canals which have recurrent infections[21]

The emitter is a flexible hollow tube coated internally with a light diffusing material of a comparable size to the tip of an ISO standard #40 file. The light is emitted over a 15 mm length of the tip with a uniform energy density. This energy density is increased by 30% at the tip. After completion of canal preparation, the canal is inoculated with the photosensitizer solution which is left in situ for a fixed period of time (60 seconds) to permit the solution to come into contact with the bacteria and diffuse through any biofilm structure.

The emitter is then placed in the root canal and irradiation carried out for 120 seconds. This has been demonstrated in the laboratory study to kill high concentrations of bacteria generally found in root canals.

Functions

- It kills all bacteria associated with all types of oral lesions
- It saves time and enables endodontictreatment in a single visit
- It works only at the infection site, reducing the need for other local and systemic
- antimicrobials
- It compliments minimally invasive treatment as a simple, adjunct to your usual
- restorative procedure
- It improves and speeds up the healing process
- It is painless and welcomed by patients especially children
- It is safe, with no known side-effects

And significant benefits for patients

- Less likelihood of failed root canal treatment
- Less complex treatment of periodontal pockets
- Less likelihood of implant failure
- Less need for aggressive antimicrobials and systemic antibiotics
- Less risk of pulpal exposure in treating deep decay
- Less trauma for children and dental phobics

CONCLUSIONS

The results of the study show that the PAD technique was successful in eliminating all the culturable bacteria when the correct combination of photosensitizer and correct energy dose are usedand where both the light and the photosensitizer reach the bacteria.It highlighted the need for care in the use of the emitter toensure that it is not bent too tightly or trapped in the canal.

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