FotoSanNewsletter

# Light Activated Disinfection (LAD) for Endodontic disinfection

## CONCLUSIONS

- ✦ One visit endodontic treatment is preferable, if applicable in practice.
- ✦ Thorough CMD (chemo mechanical debridement) is the foundation of any successful endodontic treatment. However, it not necessarily adequate as a stand alone procedure.
- ✦ LAD treatment as an adjunct to CMD is an effective way to further eliminate microorganisms from the root canal. It has been proven by in vitro, ex vivo and clinical studies.
- ✦ LAD treatment is effective against all microorganisms - even if they are multi antibiotic resistant.
- ✦ LAD treatment is dose-response dependent, i.e. more light kills more microorganisms. With enough light ( provided they can be reached by the photosensitizer/light) ALL microorganisms can be killed.
- ✦ LAD treatment is better documented than most other adjunctive CMD options.


**In this issue of the FotoSan Newsletter we focus on the endodontic use of LAD as a prelude to the ESE conference in Rome. Meet CMS Dental at stand 9.**

## PART ONE
## Do we really need another method to disinfect the root canal?

With more than 100 million procedures a year, the root canal treatment is one of the most common elective procedures performed on patients. Prospective studies, carried out by endo specialists, on a small number of teeth showed a 5 year success rate of 80-90% (see ref. 1). Retrospective studies though, with a larger number of the population being radiographically evaluated 5 years after the root canal treatment, show another picture with failure rates of 40-50% (ref. table 1).

**The high failure rate can be caused by one of the following reasons**

(re)-infection, or an inadequate elimination of the primary infection.
Sjögren (2) showed in a 5 year radiographical follow up on 53 teeth with apical periodontitis, that the teeth successfully disinfected before the root canal filling had a success rate of 94%. On the other hand the teeth not sufficiently disinfected

before the root canal filling, had a success rate of ONLY 68%.
The conclusion is very obvious: A clean canal is the key to obtaining a high success rate.
It sounds easy enough, but because of the different anatomy of root canals, it is not that simple.

The differences in anatomy make it difficult and sometimes impossible to clean the canals sufficiently even with todays new flexible Ni-Ti files. Several recent studies show (ref. 3,4) that the surface in the apical third is hardly cleaned by the files. A chemical or thermal disinfection is therefore necessary. A thermal disinfection may be obtained by, for example by a surgical laser, a method not further discussed in this article, due to the high acquisition costs preventing it from becoming a “mainstream” treatment within endodontics.

One study indicates a possible change with age, showing that root canals in older patients are more difficult to disinfect properly. (ref. 6). This is not really surprising and could be explained at least partially by anatomical changes in the root canals with age, also supporting that non-elimination of bacteria in the first place is a key factor to failure.

With chemical disinfection the most used method in endodontics is rinsing with a solution of 5,25% NaOCl.
Most in vitro studies (ref. 5) show inadequate results of rinsing the root canals even with a solution of 5,25% NaOCl. Some authors recommend rinsing with a combination of 17% EDTA and 5,25% NaOCl plus 2% chlorhexidine.

## One or two visit endodontics?

Another possible method of eliminating microorganisms in the root canal is to use and inter appointment dressing of a disinfectant or antibiotics in the root canal. A traditional product, still in use is calcium hydroxide (CaOH). Sathorn (ref.7) published in 2007 a review article, a meta-analysis of 8 articles on the effect of CaOH as dressing in root canal treatment. The conclusion was that no significant clinical effect was found. The result with antibiotics dressings is not better, e.g. Pulpomixine. There is only one published study (ref. 8) and it is showing no effect. It is surprising that antibiotics have been used over

Tabel 1: Listing of various retrospective studies of the failure rate after endodontic treatment.

| number of teeth | failure | country | ref |
|---|---|---|---|
| 320 | 35 % | Litauen | 13 |
| 6339 | 45 % | Hviderusland | 14 |
| 2051 | 50 % | Brasilien | 15 |
| 314 | 44 % | Canada | 16 |
| 93 | 65 % | Spanien | 17 |
| 93 | 40 % | Belgien | 18 |
| 773 | 52 % | Danmark | 19 |

the last 20-30 years without any foundation in scientific clinical studies. Sathorn (ref. 9) published in 2005 a review article with a meta-analysis of one visit endo treatment compared to multiple endo treatments showing a slight increase in the healing, in favor of one visit endo but without any statistical significance ($p=0.38$).

In favor of 5% Iodine treatment (iodine potassium-iodide IDI) Kvist from Göteborg (ref. 10) in 2004, was comparing a one visit endo with a 10 minutes 5 % IDI treatment with two visits endo, using CaOH as inter appointment dressing. He finds no significant difference in the two different methods. It raises the question whether it is a sufficient reason for using Iodine. Sathorn (ref.9) showed as mentioned, that one visit endo gives at least as good results when compared to multiple endo treatments. In another article (ref. 7) from 2007 he also showed that CaOH has no effect!
It can hardly be satisfactory, using a method tested in a meta-analysis, to be as good as something that does not work. Let us take a look at other published studies on the use of Iodine for endodontic disinfection? Tello-Barbaran (ref. 11) from Peru published in 2010 an in vitro study with root canals incubated with E. faecalis. After instrumentation and rinsing with 1% NaOCl, followed by rinsing with 2% IDI in 15 minutes in one group or in 5 minutes and a second group. The killing effect was 95% for the 15 minutes group and 44% for the 5 minutes group! Please note that the solution

was 2% and not 5%.It is important to note that the root canals were rinsed rather than using IDI as a dressing (as is typically done in practice). Another older clinical study was performed in 1999 in Gothenburg by Molander (12) on patients with apical periodontitis. Molander tried to increase the elimination of bacteria in the root canals with two different solutions A) pretreatment with a 5% IDI solution over a period of 5-7 days before the CaOH inlay is placed or B) a CaOH inlay over a period of 2 months. None of these two methods resulted in a significant reduction of the numbers of bacteria types nor the number of bacteria, cultured after treatment.

## PART TWO

**Terminologi:**

**PDT** means **P**hoto **D**ynamic **T**herapy and is the broad expression for light activating a chemical (or pharmaceutical). Used in dermatology, for cancer treatment and other areas of medicine.

**PACT** stands for **P**hoto Dynamic **A**ntimicrobial **C**hemo **T**herapy.

**PAD** stands for **P**hoto **A**ctivated **D**isinfection.

**LAD** stands for **L**ight **A**ctivated **D**isinfection.

PACT, PAD and LAD are all describing the same therapy, used more or less arbitrarily by the individual author. PDT is also used by some authors to describe elimination of microorganisms.

In this NewsLetter LAD is used consequently in order not to confuse the reader.

## Is LAD treatment a suitable choice as an adjunctive treatment in endodontic disinfection?

The conclusion in Part one was that a thorough CMD (chemo mechanical debridement) is a prerequisite to obtain a satisfactory result, but as a stand alone procedure it may not be adequate. *LAD is a valid option as an adjunctive treatment to further eliminate micro organisms.*
The obvious question is; Does it really work? In fact the effect of LAD treatment for endodontic disinfection is already better documented than most other procedures and techniques already widely used and accepted, LAD/PAD/PACT has already been described in the literature since the mid nineties as a potential disinfection method in endodontics. In the beginning laser light was used as the light source.

**Schlafer et al., 2010, in vitro/ex vivo, (abstract 1)**
Schlafer is among the first scientists, showing that a non-coherent, meaning “an ordinary light source” is efficient in combination with toluidine blue (TBO). He used a super LED, with an output power of around 2 Watt. The spectrum of the light in those types of LEDs is about 10-20 nm wide (85%), whereas for laser light it is only about 1 nm. In practice it is not important, because the photosensitizer typically has a wider window for activation. Schlafer showed, in a planktonic solution, on average 99,7% of the bacteria were killed after 30 s light using a 0.01% TBO solution. 4 bacterial strains , E.coli, E. faecalis, F. nucleatum, S. intermedius and the fungus C. albicans were used. C. albicans showed a stronger resistance, with a survival rate of 33%. This result led to more tests performed, in which Schlafer demonstrated a very essential principle of LAD treatment, a clear dose-response relationship. After 120 s light he showed that 100% of C. albicans were killed. In the last part of his study where he used S intermedius incubated in extracted teeth, 96% were killed within 30 s.

**Eick et al, 2010, in vitro, unpublished**
In a unpublished study from Bern University Eick tested LAD on 18 different microorganisms, of which 3 had been collected from patients with super infecting species. One was an anaerobic endopathogene mix and another an aerobic endopathogene mixed infection. Not surprisingly the microaerophile/anaerobic strains were the most sensitive to LAD, but the super infectious mixtures were also sensitive to the treatment. Eick also confirmed the dosage-response relation of the light dosage reaching exactly the same conclusion as Schlafer had shown with C. albicans.
The significance of Eick’s study is, that it shows that all bacteria are sensitive to LAD - although at different levels.
One question then is whether this method is useful and efficient in a clinical situation?

**Rios et al, 2011, ex vivo, (abstract 2)**
To answer this question Rios conducted a study, where he compared disinfection with rinsing with a 6% NaOCl plus rinsing with a 6% NaOCl + LAD. The study was carried out on extracted teeth incubated two weeks with E. faecalis.

Scanning electronic microscopy of a positive control group documented the presence of a biofilm like condition. Rinsing with 6% NaOCl resulted in a survival rate of bacteria of 0,66%, while rinsing plus LAD (30 seconds) reduced the survival rate to 0,1%, i.e almost 7 times less The difference was statistically significant ( p< .005).

**Ng et al. 2010, ex vivo (abstract 3)**

The clinical significance of Rios's study is supported by a study made by Ng. 52 teeth with pulpal necrosis and radiographic verified apical periodontitis were extracted. Baseline microbiological samples were taken, and the teeth were separated in two groups: 1) 26 teeth with a total of 49 canals in the CMD group, and 2) 26 teeth with a total of 52 canals in the CMD +PDT group.

Both groups had CMD performed (Profiles + 6%NaOCl + 17%EDTA).

The CMD+PDT group were also LAD treated. After each treatment, microbiological specimens from the root canals were examined. 39 bacterial strains from the root canals were cultivated. The LAD treatment gave a significant reduction of the microbiological survival (p= 0,003) compared with the CMD alone. The results are presented in table 1, showing that 86,5% of the root canals were free from bacteria after CMD+LAD treatment while only 49% were clean after CMD treatment alone. Furthermore the 7 canals being cultured positive after CMD/LAD treatment all had a level of bacteria lower than 0.1% of pre-treatment level. This compared to the CMD group where 14 canals had levels of less than 0.1%, but 11 canals had levels of bacteria over 0.1% of pre-treatment level.

**Garcez et al., 2011, in vivo (abstract 4)**

Garcez' clinical study on 21 patients, with a total of 30 anterior teeth, all previously endodontically treated including receiving antibiotics. The patients now had a clinical and a radiografically verified apical periodontitis. The 30 teeth were all reopened, the gutta percha removed, re-instrumented to file #45, rinsed with NaOCl 2,5%, and 3% $H_2O_2$ plus 17% EDTA.

Microbiological tests before instrumentation (=baseline) were carried out likewise after instrumentation/rinsing and after LAD treatment. Baseline microbiology showed 1/3 gram-negative and 2/3 gram-positive, about half anaerobic and half aerobic. They were found resistant to: ampicillin, penicillin G, vancomycin, cephalasporin, clindamycin, chloramphenicol, erythromycin and tetracycline.

After instrumentation/rinsing 10 teeth were found without bacteria (1/3) but 20 with bacterial growth (2/3). The tests carried out after LAD treatment showed all 30 teeth without bacteria. This clinical study shows clearly the potential in LAD treatment for endodontic disinfection. Naturally the fact that the bacteria killed in this study were resistant to various well known antibiotics only underline the huge potential LAD has in infection control in general.

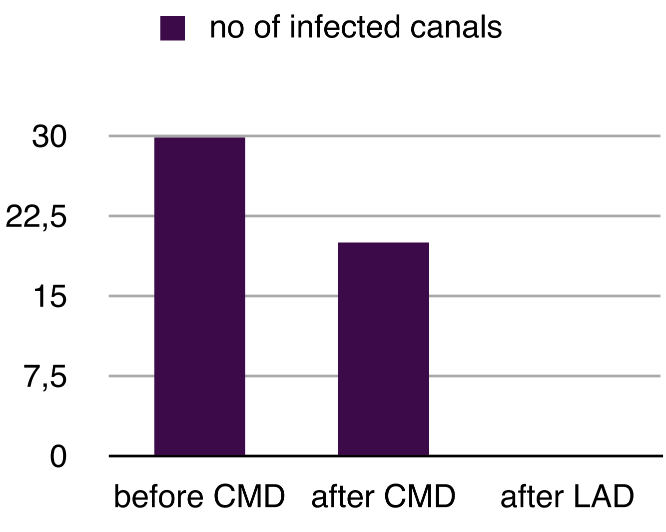


Diagram 1, after Garcez, abstract 4

**Tabel 2. Survival of bacteria after treatment (Ng, abstract 3)**

| | none | <0.1% | >0.1% | total no of canals |
|---|---|---|---|---|
| CMD no | 24 | 14 | 11 | 49 |
| CMD % | 49 % | 28 % | 22 % | |
| CMD+PDT no | 45 | 7 | 0 | 52 |
| CMD+PDT % | 87 % | 13 % | 0 % | |

# Technical discussion

## Photosensitizer

The photosensitizer (PS) serves as an energy catalyst. It is important to use chemicals that bond to target cells, in this case microorganisms. The PS absorbs the light energy at specific wavelengths, releasing this energy to transform $O^2$ into very reactive oxygen specimens (ROS). Commonly used photosensitizers are toluidine blue O (TBO) and methylene blue (MB), however there are many more. Do note however, that every PS reacts on specific wavelengths so one type of PS works with a specific light etc. The absorption spectra for TBO and MB are for example around 630 and 660 nm respectively.

All light sources will work if they emit the relevant wavelength. From this follows also that white light will be somewhat effective. However often not enough to be clinically significant.

## Tip vibration

FotoSan® features a patent pending vibration of the tip. Why is that? The reactive oxygen specimens are extremely reactive, which means they have an ultra short life time - a few nano seconds. It means they can only kill bacteria in close proximity to where they are generated. In practice the PS has to be bonded to the micro organisms. Bacteria are typically only a few microns in size. A typical root canal surface is however in the magnitude of $40 \times 10^6\ \mu m^2$. This is if it was smooth, which it is not, and if dentine tubuli are included the actual surface is many times larger.

The PS is used in a v/v concentration of 0.01%, i.e. 10.000 more volume water than active PS. The rationale behind the vibration of the tip is to make micro fluctuations of the fluid in the canal, thereby increasing the probability that a TBO molecule hits a microorganism.

## Empty or filled root canal?

The question arises as to whether the PS should be removed from the canal before using the light as some commercial sources are claiming to be better. The rationale behind emptying the root canal of PS is that non-bonded PS “steals” reactive oxygen specimens that could have been used to kill bacteria. In principle this is correct, however the advantage of having the root canal filled with a fluid when using the light, in my opinion far outweighs this potential effect. The fluid in the canal, see below, effectively works as a light guide, distributing the light beyond the actual light guide. Ideally, however, due to the before mentioned waste effect, the light guide should take up as much space in the canal as possible.

## Application tips

Principally there are two solutions: 1) A thin fiber optical cable ( typically diameter of 0.2-0.3 mm), used with a laser light source, or 2) a tapered tip, used with an LED light source. Laser enthusiasts will argue for the thin fiber, however in my opinion there are serious disadvantages with this design:

### Arguments in favor of the tapered tip design:

1) The thin cable only emits light from the tip. This means that to treat the whole canal surface, you will have to activate the light for every 1-2 mm of the canal length.
2) On the other hand, the patent pending design of the FotoSan® endo tip, emits light not only at the tip but also from three circumferential “shoulders”. This means that the whole canal surface can be treated without moving the tip. This is demonstrated very convincingly on a video made by Prof. Gamberini and Dr Plotini, available on www.cmsdental.com.
3) The tapered endo tip fills the canal well so there is a minimum of “wasted” reactive oxygen specimens attacking unbound TBO

### Arguments in favor of the thin fiber:

1) Some will argue that only the thin fiber can reach the apex.
2) It is however without practical significance, as the fluid in the root canal serve as a optical fiber in itself. This argument has been documented by a study by Nunes (20), showing that there is no significant difference on the bacterial killing in two groups of extracted teeth, where one was irradiated through a fiber ( d= 0.2 mm) to the apex, and the other group irradiated without a fiber at all, i.e. in the canal without a tip.

# The world's most powerful LAD light, now featuring:

- ✦ Bilateral identical control buttons
- ✦ Pen-grip for optimal control
- ✦ Adjustable tips
- ✦ 5 different tips
- ✦ Higher battery capacity
- ✦ Intelligent Automated Function

The endo tip emits light from the tip and from three circumferential "shoulders".
There are two perio tips - a long and a short. They both emit light from the apical 5 mm. There are two blunt tips for surface treatment, with a diameter of 4 and 8 mm respectively

## Adjustable tips

The +/- 15 degrees adjusting capability of the tip makes it easier to treat root canals and pockets anywhere in the mouth.

## Upper and lower treatment

Bilateral control buttons make it equally easy to treat upper and lower arches. You simply rotate the light in your hand - control buttons are identical on each side.

## Molar region

The reduced thickness of the light's head makes it easy to treat patients who have difficulty opening their mouth wide enough for normal access. The new short perio-tip further allows easier access.

## Faster application

We have introduced the FotoSan agent in syringes to save you time. The out-put intensity of the light is already at the maximum, so what can we do to make it faster and easier for you? The answer is the patented principle of Intelligent Automated Functions (IAF). In short it means that you press the button once and get a series of light activations. In practice we have three program modes: green, orange and red. Green is manual, orange is semiautomatic and red is fully automatic

## References:


1. **Treatment outcome in endodontics: the Toronto study--phase 4: initial treatment.** de Chevigny C.: J Endod. 2008 Mar; 34(3):258-63.
2. **Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical periodontitis. Sjögren U: Int Endod J. 1997 Sep;30(5): 297-306.**
3. **A scanning electron microscopic study of debris and smear layer remaining following use of GT rotary instruments.** Gambarini G: Int Endod J. 2002 May;35(5):422-7.
4. **Scanning electron microscopic evaluation of debris and smear layer remaining following use of ProTaper and Hero Shaper instruments in combination with NaOCl and EDTA irrigation.** Yang G.: Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Oct;106(4):e63-71.
5. **Residual Effectiveness of Final Irrigation Regimens on Enteroccus faecalis-infected Root Canals. Baca P.:**J Endod. 2011 Aug;37(8):1121-3.
6. **Effect of ethylenediaminetetraacetic acid and sodium hypochlorite irrigation on Enterococcus faecalis biofilm colonization in young and old human root canal dentin: in vitro study.** Ozdemir HO:J Endod. 2010 May;36(5):842-6.
7. **Antibacterial efficacy of calcium hydroxide intracanal dressing: a systematic review and meta-analysis.** Sathorn C.:Int Endod J. 2007 Jan;40(1):2-10.
8. **The effectiveness of some methods in eliminating bacteria from the root canal of a tooth with chronic apical periodontitis. Trusewicz M.: Ann Acad Med Stetin. 2005;51 (2):43-8.**
9. **Effectiveness of single- versus multiple-visit endodontic treatment of teeth with apical periodontitis: a systematic review and meta-analysis. Sathorn C.:**Int Endod J. 2005 Jun; 38(6):347-55.
10. **Microbiological evaluation of one- and two-visit endodontic treatment of teeth with apical periodontitis: a randomized, clinical trial. Kvist T.:**J Endod. 2004 Aug;30(8):572-6.
11. **The antimicrobial effect of iodine-potassium iodide after cleaning and shaping procedures in mesial root canals of mandibular molars.** Tello-Barbaran J.: Acta Odontol Latinoam. 2010;23(3):244-7.
12. **The antimicrobial effect of calcium hydroxide in root canals pretreated with 5% iodine potassium iodide. Molander A.:** Endod Dent Traumatol. 1999 Oct;15(5):205-9.
13. **Endodontic treatment and prevalence of apical periodontitis in an adult population of Vilnius, Lithuania.** Sidaravicius B.: Endod Dent Traumatol. 1999 Oct;15(5):210-5.
14. **Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. Kabak Y.:** Int Endod J. 2005 Apr;38(4):238-45.
15. **Periradicular status related to the quality of coronal restorations and root canal fillings in a Brazilian population.** Siqueira JF Jr.: Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2005 Sep;100(3):369-74
16. **Periapical health and treatment quality assessment of root-filled teeth in two Canadian populations.** Dugas NN.: Int Endod J. 2003 Mar;36(3):181-92.
17. **Periapical health related to the quality of root canal treatment in a Belgian population.** De Moor RJ.: Int Endod J. 2000 Mar;33(2):113-20.
18. **Periapical status and quality of root fillings and coronal restorations in an adult Spanish population.** Segura-Egea JJ.: Int Endod J. 2004 Aug;37(8):525-30.
19. **Frequency and distribution of endodontically treated teeth and apical periodontitis in an urban Danish population.** Kirkevang LL.: Int Endod J. 2001 Apr;34(3):198-205.
20. **Effectiveness of Photodynamic Therapy Against Enterococcus faecalis, With and Without the Use of an Intracanal Optical Fiber: An In Vitro Study.** Nunes MR.: Photomed Laser Surg. 2011 Jul 26


Abstract 1:

### Endodontic photoactivated disinfection using a conventional light source: an in vitro and ex vivo study

Sebastian Schlafer, DDS, Michael Vaeth, Preben Hørsted-Bindslev, DDS, and Ellen V. G. Frandsen, DrOdont, Aarhus, Denmark FACULTY OF HEALTH SCIENCES, AARHUS UNIVERSITY

**Objective:** The antimicrobial effect of photoactivated disinfection (PAD) using toluidine blue and an LED lamp was tested on endodontic pathogens in planktonic suspension and after inoculation into extracted teeth. Irradiation time was limited to 30 seconds.
**Study design:** The effect of PAD on planktonic suspensions of Escherichia coli, Candida albicans, Enterococcus faecalis, Fusobacterium nucleatum, and Streptococcus intermedius was analyzed using Poisson regression. Moreover, cultures of S. intermedius were inoculated into prepared root canals of extracted molars. The effect of PAD performed immediately after inoculation or after overnight bacterial incubation was determined by a 2-sample t test.
**Results:**Photoactivated disinfection yielded significant reductions ($P < .001$) in the viable counts of all organisms in planktonic suspension. The PAD treatment of S. intermedius in root canals yielded a mean log10 reduction of 2.60 ($P < .001$) immediately after inoculation and of 1.38 ($P < .001$) after overnight incubation.
**Conclusion:** Photoactivated disinfection using a conventional light source strongly reduces the number of viable endodontic pathogens in planktonic suspension and in root canals. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109:634-641).

Abstract 2:

### Evaluation of Photodynamic Therapy Using a Light-emitting Diode Lamp against Enterococcus faecalis in Extracted Human Teeth

Alejandro Rios, DDS, Jianing He, DMD, PhD, Gerald N. Glickman, DDS, MS, MBA, JD, Robert Spears, PhD, Emet D. Schneiderman, PhD, and Allen L. Honeyman, PhD

**Introduction:** Photodynamic therapy (PDT) with high-power lasers as the light source has been proven to be effective in disinfecting root canals. The aim of this study was to evaluate the antimicrobial effect of PDT using toluidine blue O (TBO) and a low-energy light-emitting diode (LED) lamp after the conventional disinfection protocol of 6% NaOCl.
**Methods:** Single-rooted extracted teeth were cleaned, shaped, and sealed at the apex before incubation with Enterococcus faecalis for 2 weeks. Roots were randomly assigned to five experimental groups and three control groups. Dentin shavings were collected from the root canals of all groups with a #50/.06 rotary file, colony-forming units were determined, and the bacterial survival rate was calculated for each treatment.
**Results:** The bacterial survival rate of the NaOCl/TBO/light group (0.1%) was significantly lower ($P < .005$) than the NaOCl (0.66%) and TBO/light groups (2.9%).
**Conclusions:** PDT using TBO and a LED lamp has the potential to be used as an adjunctive antimicrobial procedure in conventional endodontic therapy. (J Endod 2011;37:856–859)

Abstract 3:

**Endodontic Photodynamic Therapy Ex Vivo**

Raymond Ng, DDS, Fiza Singh, DDS, Despina A. Papamanou, DDS, Xiaoqing Song, MD, MS, Chitrang Patel, BS, Colleen Holewa, BS, Niraj Patel, BS, MS, Vanja Klepac-Ceraj, PhD, Carla R. Fontana, DDS, PhD, Ralph Kent, ScD, Tom C. Pagonis, DDS, MS,Philip P. Stashenko, DMD, PhD and Nikolaos S. Soukos, DDS, PhD

**Introduction:** The objective of this study was to evaluate the antimicrobial effects of photodynamic therapy (PDT) on infected human teeth ex vivo. **Methods:** Fifty-two freshly extracted teeth with pulpal necrosis and associated periradicular radiolucencies were obtained from 34 subjects. Twenty-six teeth with 49 canals received chemomechanical debridement (CMD) with 6% NaOCl, and 26 teeth with 52 canals received CMD plus PDT. For PDT, root canal systems were incubated with methylene blue (MB) at concentration of 50 mg/ mL for 5 minutes, followed by exposure to red light at 665 nm with an energy fluence of 30 J/cm2. The contents of root canals were sampled by flushing the canals at baseline and after CMD alone or CMD+PDT and were serially diluted and cultured on blood agar. Survival fractions were calculated by counting colony-forming units (CFUs). Partial characterization of root canal species at baseline and after CMD alone or CMD+PDT was performed by using DNA probes to a panel of 39 endodontic species in the checkerboard assay. **Results:** The Mantel- Haenszel c2 test for treatment effects demonstrated the better performance of CMD +PDT over CMD (P = .026). CMD+PDT significantly reduced the frequency of positive canals relative to CMD alone (P = .0003). After CMD+PDT, 45 of 52 canals (86.5%) had no CFUs as compared with 24 of 49 canals (49%) treated with CMD (canal flush samples). The CFU reductions were similar when teeth or canals were treated as independent entities. Post-treatment detection levels for all species were markedly lower for canals treated by CMD+PDT than they were for those treated by CMD alone. Bacterial species within dentinal tubules were detected in 17 of 22 (77.3%) and 15 of 29 (51.7%) canals in the CMD and CMD+PDT groups, respectively (P = .034). **Conclusions:** Data indicate that PDT significantly reduces residual bacteria within the root canal system, and that PDT, if further enhanced by technical improvements, holds substantial promise as an adjunct to CMD. (J Endod 2011;37:217–222)

---

Abstract 4:

**Photodynamic Therapy Associated with Conventional Endodontic Treatment in Patients with Antibiotic-resistant Microflora: A Preliminary Report**

Aguinaldo S. Garcez, PhD, Silvia C. Nun̆ez, PhD, Michael R. Hamblim, PhD, Hideo Suzuki, and Martha S. Ribeiro, PhD.

**Introduction:** This study reports the antimicrobial effect of photodynamic therapy (PDT) combined with endodontic treatment in patients with necrotic pulp infected with microflora resistant to a previous antibiotic therapy.
**Methods:** Thirty anterior teeth from 21 patients with periapical lesions that had been treated with conventional endodontic treatment and antibiotic therapy were selected. Microbiological samples were taken (1) after accessing the root canal, (2) after endodontic therapy, and (3) after PDT. **Results:** All the patients had at least 1 microorganism resistant to antibiotics. PDT used polyethylenimine chlorin(e6) as a photosensitizer and a diode laser as a light source (P = 40 mW, t = 4minutes, E = 9.6 J). Endodontic therapy alone produced a significant reduction in numbers of microbial species but only 3 teeth were free of bacteria, whereas the combination of endodontic therapy with PDT eliminated all drug-resistant species and all teeth were bacteria-free.
**Conclusions:** The use of PDT added to conventional endodontic treatment leads to a further major reduction of microbial load. PDT is an efficient treatment to kill multi-drug resistant microorganisms. (J Endod 2010;36:1463–1466)

FotoSanNewsletter is published by CMS Dental.
Editor: Jimmie Kert, MD: kert@cmsdental.dk



CMS Dental
Ragnagade 7
2100 Copenhagen Ø
www.cmsdental.com

info@cmsdental.dk
Tel.: +45 32 57 30 00
Fax: +45 32 57 10 23