Photo-activated chemo therapy

Scientific studies
Photodynamic Inactivation of Microbial Pathogens: Medical and Environmental Applications, Royal Society of Chemistry; 1 edition (June 11, 2013)
Photodynamic therapy (PDT) was discovered over one hundred years ago after observing the death of microorganisms upon exposure to dye and light. It is the combination of non-toxic dyes and harmless visible light that, in the presence of oxygen, produce highly toxic reactive species. The principal medical application during the last century was in cancer therapy but, in these days of rising antibiotic resistance, PDT shows increasing promise as an alternative approach to treating infections. PDT has also been used in blood product sterilization, periodontology, acne reduction, and the treatment of viral lesions such as those caused by human papilloma virus. It may also have potential as an environmentally friendly pesticide. This is the first and only book to comprehensively cover the use of light and photosensitising agents for controlling microbial pathogens. It provides a comprehensive and up-to-date coverage of an emerging field. There are several chapters on the design of antimicrobial photosensitizers, their use to kill pathogenic organisms and their success in treating infections in animal models. It has long been known that gram-positive bacteria are highly susceptible to photoinactivation but the book also discusses means of widening the range of microorganisms that can be tackled by PDT. Edited by two pioneers in the application of PDT to medical and environmental issues, this book covers the basic science, translational research in animals, and the clinical applications in various medical specialities. It represents an indispensable resource for microbiologists and infectious disease doctors as well as dentists, dermatologists, gastroenterologists and transplant specialists.

Microbial biofilms in the oral cavity are involved in the etiology of various oral conditions, including caries, periodontal and endodontic diseases, oral malodor, denture stomatitis, candidiasis and dental implant failures. It is generally recognized that the growth of bacteria in biofilms imparts a substantial decrease in susceptibility to antimicrobial agents compared with cultures grown in suspension. It is therefore not surprising that bacteria growing in dental plaque, a naturally occurring biofilm, display increased resistance to antimicrobial agents. Current treatment techniques involve either periodic mechanical disruption of oral microbial biofilms or maintaining therapeutic concentrations of antimicrobials in the oral cavity, both of which are fraught with limitations. The development of alternative antibacterial therapeutic strategies therefore becomes important in the evolution of methods to control microbial growth in the oral cavity. The use of photodynamic therapy for inactivating microorganisms was first demonstrated more than 100 years ago, when Oscar Raab reported the lethal effect of acridine hydrochloride and visible light on Paramecia caudatum. Photodynamic therapy for human infections is based on the concept that an agent (a photosensitizer) which absorbs light can be preferentially taken up by bacteria and subsequently activated by light of the appropriate wavelength in the presence of oxygen to generate singlet oxygen and free radicals that are cytotoxic to microorganisms. Because of the primitive molecular nature of singlet oxygen, it is unlikely that microorganisms would develop resistance to the cytotoxic action. Photodynamic therapy has emerged as an alternative to antimicrobial regimes and mechanical means in eliminating dental plaque species as a result of the pioneering work of Professor Michael Wilson and colleagues at the Eastman Dental Institute, University College London, UK. In this review, we propose to provide an overview of photodynamic therapy with emphasis on its current status as an antimicrobial therapy to control oral bacteria, and review the progress that has been made in the last 15 years concerning the applications of photodynamic therapy for targeting biofilm-associated oral infections. Problems and challenges that have arisen will be identified and discussed. Finally, new frontiers of antimicrobial photodynamic therapy research will be introduced, including targeting strategies that may open new opportunities for the maintenance of bacterial homeostasis in dental plaque, thereby providing the opportunity for more effective disease prevention and control.

PACT for the Treatment of Periodontitis and Periimplantitis
The objective of this work was to compare the effects of antimicrobial photodynamic therapy (PDT), diode soft laser therapy (DSL), and thorough deep scaling and root planing (SRP) for treatment of residual pockets. Thirty-two subjects with a history of non-surgical treatment for chronic periodontitis were included. Residual pockets >4 mm and bleeding upon probing were debrided with an ultrasonic device and then subjected to either PDT, DSL, or SRP. Pocket probing depth (PPD), bleeding on probing (BOP), and gingival recession were monitored over 6 months. Counts of four microorganisms were determined by direct hybridization with RNA probes. PPD decreased from 5.6 ± 1.0 to 3.8 ± 1.1 in 6 months (p < 0.001), and BOP decreased from 100% to 52% (p < 0.01). The risk for a site to remain >4 mm with BOP depended on initial PPD (p = 0.036) and was higher if treated with DSL (p = 0.034). Frequencies of three microorganisms were significantly lower in PDT- and SRP-treated than in DSL-treated quadrants (p = 0.02) after 14 days, but not at months 2 and 6. All three treatments resulted in a significant clinical improvement. PDT and SRP suppressed Porphyromonas gingivalis, Tannerella forsythia, and Treponema denticola stronger, and resulted in fewer persisting pockets after 6 months, than DSL application.

OBJECTIVE: To compare the adjunctive clinical effects in the non-surgical treatment of peri-implantitis with either local drug delivery (LDD) or photodynamic therapy (PDT).
MATERIAL AND METHODS: Forty subjects with initial peri-implantitis, i.e. pocket probing depths (PPD) 4-6 mm with concomitant bleeding on probing (BoP) and marginal bone loss ranging from 0.5 to 2 mm between delivery of the reconstruction and pre-screening appointment were randomly assigned to two treatment groups. All implants underwent mechanical debridement with titanium curettes, followed by a glycine-based powder airpolishing. Implants in the test group (n = 20) received adjunctive PDT, whereas monocyclic microphoreses were locally delivered into the peri-implant pockets of control implants (n = 20). At sites with residual BoP treatment was repeated after 3 and 6 months. The primary outcome variable was the change in the number of sites with BoP. Secondary outcome variables were changes in PPD, in clinical attachment level (CAL), and in mucosal recession (REC).
RESULTS: After 3 months, implants of both groups yielded a statistically significant reduction (P < 0.0001) in the number of BoP-positive sites compared with baseline (LDD: from 4.41 ± 1.47 to 2.20 ± 1.28, PDT: from 4.03 ± 1.66 to 2.26 ± 1.28). After 6 months, complete resolution of mucosal inflammation was obtained in 15% of the implants in the control group and in 30% of the implants in the test group (P = 0.16). After 3 months, changes in LDD, REC, and modified Plaque Index (mPII) were statistically significantly different from baseline (P < 0.05). No statistically significant changes (P > 0.05) occurred between 3 and 6 months. CAL measurements did not yield statistically significant changes (P > 0.05) in both groups during the 6-month observation time. Between-group comparisons revealed no statistically significant differences (P > 0.05) at baseline, 3 and 6 months with the exception of the mPII after 6 months.
CONCLUSIONS: In cases of initial peri-implantitis, non-surgical mechanical debridement with adjunctive use of PDT is equally effective in the reduction of mucosal inflammation as with the adjunctive use of monocyclic microphoreses up to 6 months. Adjunctive PDT may represent an alternative treatment modality in the non-surgical management of initial peri-implantitis. Complete resolution of inflammation, however, was not routinely achieved with either of the adjunctive therapies.
Microbial counts were significantly reduced about 30% to 40% immediately after debridement of periodontopathy without damaging effects to adjacent normal tissues. The aim of this study was to investigate whether TB-mediated photosensitization exerted damaging effects to periodontal tissues in mice. Lasers Med Sci. 2008 Feb 1. [Epub ahead of print]


OBJECTIVE: The aim of the present study was to compare the effectiveness of a photo-disinfection process to that of scaling and root planing (SRP) for non-surgical periodontal treatment. METHODOLOGY: Thirty-three subjects with moderate to advanced periodontal disease were randomly treated in one of three study arms with either photodisinfection (PD) alone (Group 1) using a diode laser and photosensitizer combination, with SRP alone (Group 2), or with SRP and PD combined (Group 3). Clinical assessments of bleeding on probing (BOP), probing pocket depth (PPD), and clinical attachment level (CAL) were made at baseline, three weeks, six weeks, and 12 weeks following therapy. RESULTS: No difference in any of the investigated parameters was observed at baseline between the three groups. The mean value of BOP decreased in the PD group (Group 1) from baseline by 71% at six weeks and 73% at 12 weeks, and in the SRP alone group (Group 2) from baseline by 43% at six weeks and 56% at 12 weeks. The BOP in the combined SRP + PD group (Group 3) decreased from baseline by 65% at six and 59% at 12 weeks. The sites treated with PD alone demonstrated mean CAL gains of 0.09 +/- 0.38 mm and 0.14 +/- 0.65 mm at six and 12 weeks, respectively. Those sites treated with SRP alone demonstrated mean CAL gains of 0.37 +/- 0.34 mm and of 0.36 +/- 0.35 mm at six and 12 weeks, respectively. The final gain of SRP + PD demonstrated mean CAL gains of 0.92 +/- 0.62 mm and 0.86 +/- 0.61 mm at six and 12 weeks, respectively (p < 0.01 for six weeks and p < 0.02 for 12 weeks when compared to SRP alone). The sites treated with PD alone demonstrated mean PPD reductions of 0.69 +/- 0.33 mm and of 0.67 +/- 0.44 mm at six and 12 weeks, respectively. Those sites treated with SRP alone demonstrated mean PPD reductions of 0.78 +/- 0.47 mm and 0.74 +/- 0.43 mm at six and 12 weeks, respectively. The final gain of SRP + PD demonstrated mean PPD reductions of 1.16 +/- 0.39 mm and 1.11 +/- 0.53 at six and 12 weeks, respectively (p < 0.06 for six weeks and p < 0.05 for 12 weeks when compared to SRP alone). CONCLUSION: Within the limits of the present study, it can be concluded that SRP combined with photodisinfection leads to significant improvements of the investigated parameters over the use of SRP alone.


BACKGROUND: The aim of this study was to assess the effect of adjunctive antimicrobial photodynamic therapy (aPDT) in chronic periodontitis. MATERIAL AND METHODS: Twenty patients with untreated chronic periodontitis were included. All teeth received periodontal treatment comprising scaling and root planing. Using a split-mouth design, two quadrants (test group) were additionally treated with aPDT. Sulcus fluid flow rate (SFRR) and bleeding on probing (BOP) were assessed at baseline, 1 week and 3 months after treatment. Relative attachment level (RAL), probing depths (PD) and gingival recession (GR) were evaluated at baseline and 3 months after treatment. RESULTS: Baseline median values for PD, GR and RAL were not different in the test group and control groups. Values for RAL, PD, SFRR and BOP decreased significantly 3 months after treatment in the control group (median RAL: -0.35 mm, inter-quartile range: 0.21 mm), with a higher impact on the sites treated with adjunctive aPDT (median RAL -0.67 mm, inter-quartile range: 0.36 mm, p < 0.05). GR increased 3 months after treatment with and without adjunctive aPDT (p < 0.05), with no difference between the groups (p = 0.50). CONCLUSIONS: In patients with chronic periodontitis, clinical outcomes of conventional subgingival debridement can be improved by adjunctive aPDT.


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mm after 3 months (P <0.05), and in the SRP group, from 10.53 +/- 2.30 mm at baseline to 9.01 +/- 3.05 mm after 3 months. CONCLUSION: PDT and SRP showed similar clinical results in the non-surgical treatment of aggressive periodontitis.

Lulic M, Leigener Görg J, Salvi GE, Ramseyer CA, Matteos N, Lang NP. One-year outcomes of repeated adjunctive photodynamic therapy during periodontal therapy, but only improved bleeding on probing (BoP) in maintenance patients after a single use. Repeated PDT has not been addressed. OBJECTIVES: To study the possible added benefits of repeated adjunctive PDT to conventional treatment of residual pockets in patients enrolled in periodontal maintenance. MATERIAL AND METHODS: Ten maintenance patients with 70 residual pockets (probing pocket depth (PPD)≥5 mm) were randomly assigned for treatment five times in 2 weeks (Days 0, 1, 2, 7, 14) with PDT (test) or non-activated laser (control) following debridement. The primary outcome variable was PPD, and the secondary variables were clinical attachment level (CAL) and BoP. These were assessed at 3, 6 and 12 months following the interventions. RESULTS: Greater PPD reductions were observed in the test (-0.67 +/- 0.34; P=0.01) compared with the control patients (-0.04 +/- 0.33; NS) after 6 months. Significant CAL gain (+0.52 +/- 0.31; p=0.01) was noted for the test, but not in the control (-0.27 +/- 0.52; NS) patients after 6 months. BoP percentages decreased significantly in test (97.64%, 67%, 77%), but not in control patients after 3, 6 and 12 months. CONCLUSIONS: Repeated (five times) PDT adjunctive to debridement yielded improved clinical outcomes in residual pockets in maintenance patients. The effects were best documented after 6 months.

PACT for Caries Sterilisation


Several photosensitizers have been used against oral bacteria without standardization. Single oxygen (1O2) is an aggressive chemical species that can kill cells through apoptosis or necrosis. Objective: to compare the antimicrobial activity of photodynamic therapy (PDT) with different photosensitizers at the same concentration against Streptococcus mutans. In addition, the (1O2)2 production of each photosensitizer was determined. The photosensitizers (163.5 μM) methylene blue (MB), toluidine blue ortho (TBO) and malachite green (MG) were activated with a light-emitting diode (LED; ≈636 nm), while eosin (EOS), erythrosine (ERI) and rose bengal (RB) were irradiated with a curing light (λ=570 nm). Light sources were operated at 24 J cm(-2). For each photosensitizer, 40 randomized assays (n=10 per condition) were performed under one of the following experimental conditions: no light irradiation or photosensitizer, irradiation only, photosensitizer only or irradiation in the presence of a photosensitizer. After treatment, serial dilutions of S. mutans were seeded onto brain heart infusion agar to determine viability in colony-forming units per millilitre (CFU mL(-1)). Generation of (1O2)2 was analyzed by tryptophan photooxidation, and the decay constant was estimated. Results were analyzed by one-way ANOVA and the Tukey-Kramer test (p<0.05). PDT with irradiation in the presence of the photosensitizers TBO and MG was effective in reducing S. mutans counts by 3 and 1.4 logs, respectively (p<0.01), compared to their respective untreated controls. MB generated 1.3 times more (1O2)2 than TBO, and both produced significantly higher concentrations of singlet oxygen than the other photosensitizers. Since in vitro bulk (1O2)2 production does not indicate that (1)


Conclusion: Effective killing of 10 4 cfu S mutans was achieved with a range of energy densities using both HeNe and GaAlAs lasers after passage of the light through demineralised dentine discs using two photosensitisers Toluidine Blue O and AlPcS. Similar kill levels were observed when S mutans was suspended in a collagen matrix prior to exposure to the photosensitiser and light. The results imply that lethal photosensitisation may be effective at killing S mutans in a carious lesion even when the organism is suspended in demineralised dentine.


Summary: The study examined the effect of variable energy doses of light at 635nm from a novel delivery system using a 100mW diode laser and a photosensitiser. The system killed up to 10 9cfu/ml S mutans in planktonic solution. The antibacterial action was directly proportional to the energy doses rather than power output. Energy dose of 1.8J killed 10% of bacteria present. Bacteria could be killed to significant levels within 30 seconds.


Summary: Effective killing of S mutans imbedded in a collagen matrix was achieved using a photosensitiser TBO [10μg/ml] in conjunction with a 100mW 635nm diode laser with the light delivered via an isotropic tip. The results showed that Photo-Activated Disinfection


Photodynamic antibacterial therapy (PACT) promotes bacterial death as a result of the photosensitization of microbial components. This study evaluated the effect of PACT on dentine caries produced in situ. Over the course of 14 d, 20 volunteers wore intra-oral devices containing human dentine slabs that were treated 10 times daily with a 40% sucrose solution. Afterwards, the antibacterial effect of toluidine blue O, associated with 47 or 94 J/cm(2) of a light-emitting diode, was evaluated. Before and after the treatments, dentine samples were analysed with regard to the total number of microorganisms, total streptococci, mutants streptococci, and lactobacilli. Significant reductions in the bacterial count were observed for PACT with both energy densities tested, with the following values observed for 47 and 94 J/cm(2) of irradiation: for total streptococci, 3.45 and 5.18; for mutants streptococci, 3.08 and 4.16; for lactobacilli, 3.24 and 4.66; and for total microorganisms, 4.29 and 5.43, respectively. The control, treated with 94 J/cm(2) of irradiation alone, was also effective against all bacteria. To conclude, PACT was effective in killing oral microorganisms present in dentine caries produced in situ and may be a useful technique for eliminating bacteria from dentine carious lesions before restoration.


OBJECTIVES: The purpose of this study was to evaluate the antimicrobial effect of toluidine blue O (TBO), in combination with either a helium/ neon (He/Ne) laser or a light-emitting diode (LED), on the viability and architecture of Streptococcus mutans biofilms. METHODS: Biofilms were grown on hydroxyapatite discs in a constant depth film fermentor fed with artificial saliva that was supplemented with 2% sucrose four times a day, thus producing a typical, 'Stephan pH curve'. Photodynamic therapy was subsequently carried out on biofilms of various ages with light from either the HeNe laser or LED using energy densities of between 49 and 294 J/cm(2). RESULTS: Significant decreases in the viability of S. mutans biofilms were only observed when biofilms were exposed to both TBO and light, when reductions in viability of up to 99.99% were observed with both light sources. Overall, the results showed that the bactericidal effect was light dose-dependent and that older biofilms were less susceptible to photodynamic therapy. Confocal laser scanning microscopy images suggested that lethal photosensitization occurred predominantly in the outermost layers of the biofilms. CONCLUSIONS: Photodynamic therapy may be a useful approach in the treatment of dental plaque-related diseases.

can achieve appreciable kills of oral bacteria including 5 mutants when the organisms are embedded in a collagen gel or present in cavities.


Summary. Photo-Activated Disinfection has been successfully used in operative dentistry as a means of disinfecting residual softened cavities where exposure is likely. This results in the removal of less tooth tissue and may improve the prognosis of treatment. In endodontics, PAD provides a means whereby canals can be effectively disinfected. This suggests that the dental surgeon can be confident that micro-organisms can be effectively killed prior to obturation and restoration. PAD has other potential applications and further ongoing research work is currently being conducted prior to its extrapolation to the clinical situation.

PACT for Root Canal Disinfection


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 periapical 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 μg/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 χ² 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 for those treated by CMD alone. Bacterial species within dental 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.


Epub 2012 Jan 24.

INTRODUCTION: This study evaluated the in vivo response of apical and periapical tissues of dogs’ teeth with apical periodontitis after one-session endodontic treatment with and without antimicrobial photodynamic therapy (aPDT). METHODS: Sixty root canals with experimentally induced apical periodontitis were instrumented and assigned to 4 groups receiving aPDT and root canal filling (RCF) or not: group aPDT+RCF+ (n = 20); aPDT (photosensitizer methylene blue at 10 mg/mL for 3 minutes and diode laser [660 nm, 60 mW/cm² for 1 minute] in the same session); group aPDT+RCF+ (n = 10); group aPDT+RCF− (n = 10), and group aPDT+RCF− (n = 20). Teeth were restored, and the animals were killed after 90 days. Sections from the maxillae and mandibles were stained with hematoxylin-eosin and Mallory trichrome and examined under light microscopy. Descriptive (ie, newly formed apical mineralized tissue, periapical inflammatory infiltrate, apical periodontal ligament thickness, and mineralized tissue resorption) and quantitative (ie, peripical lesion size and number of inflammatory cells) microscopic analysis was performed. Quantitative data were analyzed by the Kruskal-Wallis and Dunn tests (α = .05).

RESULTS: In the aPDT-treated groups, the periapical region was moderately/severely enlarged with no inflammatory cells, moderate neangiogenesis and fibrogenesis, and the smallest periapical lesions. CONCLUSIONS: Although apical closure by mineralized tissue deposition was not achieved, the absence of inflammatory cells, moderate neangiogenesis, and fibrogenesis in the periapical region in the groups treated with aPDT indicate that this can be a promising adjunct therapy to cleaning and shaping procedures in teeth with apical periodontitis undergoing one-session endodontic treatment.

Garcez AS, Nuñez SC, Hamblin MR, Ribeiro MS.


This study analyzed the antimicrobial effect of photodynamic therapy (PDT) in association with endodontic treatment. Twenty patients were selected. Microbiological samples were taken after accessing the canal, endodontic therapy, and PDT. At the end of the first session, the root canal was filled with Ca(OH)², and after 1 week, a second session of the therapy was performed. Endodontic therapy gave a mean reduction of 1.08 log. The combination with PDT significantly enhanced the reduction (1.83 log, p = 0.00002). The second endodontic session gave a similar diminution to the first (1.14 log), and the second PDT was significantly more effective than the first (p = 0.002). The total second reduction was significantly higher than the second endodontic therapy (p = 0.0000005). The total first + second reduction (3.19 log) was significantly different from the first combination (p = 0.00006). Results suggest that the use of PDT added to endodontic treatment leads to an enhanced decrease of bacterial load and may be an appropriate approach for the treatment of oral infections.

Pearson G J, Bonsor S J

Improved Restoration in Caries and root canals using a novel disinfection technique. As published in Dentistry, Oct. 2004, revised March 2005 to include most recent information

Conclusion: In dental caries the use of PAD can eliminate residual bacteria in softened dentine and provide an environment which encourages rapid reha-Ling. This has led to its use in minimally invasive techniques in endodontics, despite following clinical “best practice.” 20% of canals remained infected after conventional chemo-mechanical treatment. The use of PAD as the disinfectant in conjunction with a cleanser such as citric acid rendered these canals bacteria free. Early indications of follow-up are favourable with strong evidence of peri-radicular healing in all cases.


Conclusion: PAD killed endodontic bacteria at statistically significant levels compared to controls. Kills varied with bacterial species.

Bonsor S J, Nichol R, Reid T M S, Pearson G J

Microbiological evaluation of Photo-Activated Disinfection in endodontics (An in vivo study). British Dental Journal 2006; 200: 337-341

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

Bonsor S J, Nichol R, Reid T M S, Pearson G J


Conclusion: Within the limits of the current study, the use of an alternative means of root canal disinfection to sodium hypochlorite has been shown to be more effective at reducing or eliminating bacterial load in the canals.

Photo Activated Disinfection: paintball endodontics

Roots 2007 2:28-43

Although extensive consistent evidence is not yet available, PAD seems to have a high potential for disinfection of root canals. Mandatory to beneficial use of adjunctive PAD treatment, all steps in routine endodontic treatment should be followed carefully. PAD does not replace shaping, cleaning and smear layer and biofilm management, but can be used in hand with routine endodontic treatment to improve outcome. This is consistent with minimally invasive endodontics.

Fonseca MB, Júnior PO, Pallotta RC, Filho HF, Denardin OV, Rapoport A, Dedivitis RA, Vernozi JF, Genovese WJ, Ricardo AL.

Photodynamic therapy for root canals infected with Enterococcus faecalis.


OBJECTIVE: The aim of this study was to investigate the effects of photodynamic therapy (PDT) on endodontic pathogens by evaluating the decrease in numbers of Enterococcus faecalis colonies in the canals of extracted human teeth. BACKGROUND DATA: Failure in endodontics is usually related to inadequate cleaning and disinfection of the root canal system. This is due to the establishment of microorganisms in areas where the instruments and chemical agents used during root canal preparation cannot eliminate them. PDT is a complementary therapeutic method that could be used to eliminate these remaining bacteria. PDT is a process in which radiation acts on a dye that is applied to the target organism, resulting in bacterial death. MATERIALS AND METHODS: Forty-six uniradicular teeth had their canals contaminated with bacteria and were incubated for 48 h at 35 degrees C. After that, the teeth were divided into a control group (CG) and a test group (TG). The 23 CG teeth did not undergo any intervention, whereas in the TG the teeth received a solution of 0.0125% toluidine blue for 5 min followed by irradiation using a 50-mW diode laser (Ga-Al-As) at a wavelength of 660 nm. Bacterial samples were taken before and after irradiation. In each of the samples, the number of colony-forming units (CFU) was counted. RESULTS: The mean decrease in CFU was 99.9% in the TG, whereas in the CG an increase of 2.6% was observed. CONCLUSION: PDT was effective as a bactericidal agent in Enterococcus faecalis-contaminated root canals.

PACT for Soft Tissue Treatment

Souza RC, Junqueira JC, Rossoni RD, Pereira CA, Munin E, Jorge AO.


This study was to evaluate specific effects of photodynamic therapy (energy density 15.8 J/cm², 26.3 J/cm² and 39.5 J/cm²) using methylene blue, toluidine blue and malachite green as photosensitizers and low-power laser irradiation on the viability of Candida albicans. Suspensions of C. albicans containing 10⁶ cells/ml were standardized in a spectrophotometer. For each dye, 120 assays, divided into four groups according to the following experimental conditions, were carried out: laser irradiation in the presence of the photosensitizer; laser irradiation only; treatment with the photosensitizer only; no exposure to laser light or photosensitizer. Next, serial dilutions were prepared and seeded onto Sabouraud dextrose agar for the determination of the number of colony-forming units per milliliter (CFU/ml). The results were subjected to analysis of variance and the Tukey test (P < 0.05). Photodynamic therapy using the photosensitizers tested was effective in reducing the number of C. albicans. The number of CFU/ml was reduced by between 0.54 log₁₀ and 3.07 log₁₀ and depended on the laser energy density used. Toluidine blue, methylene blue and malachite green were effective photosensitizers in antimicrobial photodynamic therapy against C. albicans, as was low-power laser irradiation alone.

Marotti J, Aranha AC, Eduardo Cde P, Ribeiro MS.

Photodynamic therapy can be effective as a treatment for herpess simplex labialis. Photomed Laser Surg. 2009 Apr;27(2):357-63.

BACKGROUND DATA AND OBJECTIVE: Herpes is a common infectious disease that is caused by human herpesviruses. Several treatments have been proposed, but none of them prevent reactivation of the virus. This article describes the use of photodynamic therapy (PDT) as a treatment for herpes lesions, and reports on four cases. MATERIALS AND METHODS: PDT was used as an adjuvant therapy for the treatment of herpes labialis in four patients. A special type of 0.01% (m/V) of methylene blue solution was applied to the vesicular stage of herpesviral disease and the lesions were irradiated with laser energy (wavelength 660 nm, energy density 120 J/cm², output power of 40 mW, 2 min per point, 4.8 J of energy/point, at four points). After 24 h the patients returned and phototherapy was repeated with the same equipment, this time with 3.8 J/cm² and 15 mW, for a total dose of 0.6 J. The same procedure was repeated 72 h and 1 wk later. RESULTS: Treatment with low-level laser therapy can be considered as an option in the treatment of herpes labialis, and decreases the frequency of vesicle recurrence and provides comfort for patients. No significant acute side effects were noted and the lesions healed rapidly. CONCLUSION: Treatment of herpes labialis with PDT was effective, had no side effects, and when associated with laser phototherapy, accelerated the healing process.

Joao Paulo Tardivoa, Auro Del Giglio, Carla Santos de Oliveira, Dino Santesso Gabrielli, Hekena Couto Junqueira, Dayane Batista Tada, Divinomar Severino, Rozane de Fatima Turchielo, Mauricio S. Baptista.

Methylene blue in photodynamic therapy: From basic mechanisms to clinical applications. Photodiagnosis and Photodynamic Therapy (2005) 2, 175—191

Summary Methylene blue (MB) is a molecule that has been playing important roles in microbiology and pharmacology for some time. It has been widely used to stain living organisms, to treat methemoglobinemia, and lately it has been considered as a drug for photodynamic therapy (PDT). In this review, we start from the fundamental photophysical, photochemical and photobiological characteristics of this molecule and evolved to show in vitro and in vivo applications related to PDT. The clinical cases shown include treatments of basal cell carcinoma, Kaposi’s Sarcoma, melanoma, virus and fungal infections. We concluded that used together with a recently developed continuous light source (RLS0®), MB has the potential to treat a variety of cancerous and non-cancerous diseases, with low toxicity and no side effects.