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[Effect of photodynamic therapy on IL-1beta and MMP-8 in gingival crevicular fluid of chronic periodontitis][Article in Chinese]


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PURPOSE: Photodynamic therapy (PDT) is used in infectious disease for its antimicrobial effects. The aim of the study is to evaluate the effects of a diode laser-based photodynamic therapy on the treatment of chronic periodontitis. METHODS: Fifty eight patients with chronic periodontitis were divided into three groups. Group A was treated with scaling and root planing (SRP) plus photoactivated disinfection therapy for one time (Periowave(TM): a diode laser with a wavelength of 670nm and 0.01% methylene blue solution). In group B, the patients were treated with SRP followed by photoactivated disinfection, and a second photoactivated disinfection treatment 6 weeks later. Group C was treated with SRP alone. The irradiation time was 60 seconds at a power output of 140mW. Gingival crevicular fluid (GCF) samples from these three groups of patients were obtained before periodontal treatment, 6 weeks and 12 weeks after treatment. GCF was collected using a paper strip, and enzyme-linked immunoabsorbent assay (ELISA) was performed to determine the cytokine (IL-1beta and MMP-8) levels. The data were analyzed with SAS 6.12 software package. RESULTS: ELISA showed IL-1beta and MMP-8 levels of all groups were decreased significantly at 6-week after treatment compared to pretreatment levels. No significant inter-group differences were noted. At 12-week after treatment, the decreases in IL-1beta levels of group A and B and the decrease in MMP-8 level of group B were significantly higher than group C (P<0.05). CONCLUSIONS: Based on these findings, it appears that SRP and SRP with PDT are all effective for chronic periodontitis, but the effect of SRP with PDT may last longer. PDT therefore appears to be a useful adjunct to SRP for chronic periodontitis therapy. Supported by National "Tenth Five-Year" Key Science and Technology Research Project (Grant No.2004BA72026) and International Cooperation Project (Grant No.051012).
Photodynamic therapy as adjunct to non-surgical periodontal treatment in patients on periodontal maintenance: a randomized controlled clinical trial.


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Recent preclinical and clinical data have suggested the potential benefit of photodynamic therapy (PDT) in the treatment of periodontitis. However, currently, there are very limited data from controlled clinical trials evaluating the effect of PDT in the treatment of periodontitis. The aim of the present study was to evaluate the clinical and microbiological effects of the adjunctive use of PDT in non-surgical periodontal treatment in patients receiving supportive periodontal therapy. Twenty-four patients receiving regularly supportive periodontal therapy were randomly treated with either subgingival scaling and root planing followed by a single episode of PDT (test) or subgingival scaling and root planing alone (control). The following parameters were evaluated at baseline and at 3 months and 6 months after therapy: full mouth plaque score (FMPS), full mouth bleeding score (FMBS), bleeding on probing (BOP) at experimental sites, probing pocket depth (PPD), gingival recession (REC), and clinical attachment level (CAL). Primary outcome variables were changes in PPD and CAL. Microbiological evaluation of Aggregatibacter actinomycetemcomitans (A.a.), Porphyromonas gingivalis (P.g.), Prevotella intermedia (P.i.), Tannerella forsythensis (T.f.), Treponema denticola (T.d.), Peptostreptococcus micros (P.m.), Fusobacterium nucleatum (F.n.), Campylobacter rectus (C.r.), Eubacterium nodatum (E.n.), Eikenella corrodens (E.c.), and Capnocytophaga species (C.s.) was also performed at baseline and at 3 months and 6 months after therapy, using a commercially available polymerase chain reaction test. No differences in any of the investigated parameters were observed at baseline between the two groups. At 3 months and 6 months after treatment, there were no statistically significant differences between the groups in terms of PPD and CAL. Microbiological evaluation of Aggregatibacter actinomycetemcomitans (A.a.), Porphyromonas gingivalis (P.g.), Prevotella intermedia (P.i.), Tannerella forsythensis (T.f.), Treponema denticola (T.d.), Peptostreptococcus micros (P.m.), Fusobacterium nucleatum (F.n.), Campylobacter rectus (C.r.), Eubacterium nodatum (E.n.), Eikenella corrodens (E.c.), and Capnocytophaga species (C.s.) was also performed at baseline and at 3 months and 6 months after therapy, using a commercially available polymerase chain reaction test. No differences in any of the investigated parameters were observed at baseline between the two groups. At 3 months and 6 months after treatment, there were no statistically significant differences between the groups in terms of PPD, CAL and FMPS. At 3 months and 6 months, a statistically significantly higher improvement of BOP was found in the test group. At 3 months after therapy, the microbiological analysis showed a statistically significant reduction of F.n. and E.n. in the test group. At 6 months, statistically significantly higher numbers of E.c. and C.s. were detected in the test group. The additional application of a single episode of PDT to scaling and root planing failed to result in an additional improvement in terms of PPD reduction and CAL gain, but it resulted in significantly higher reduction of bleeding scores than following scaling and root planing alone.
Toluidine blue-mediated photodynamic effects on staphylococcal biofilms.


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Staphylococci are important causes of nosocomial and medical-device-related infections. Their virulence is attributed to the elaboration of biofilms that protect the organisms from immune system clearance and to increased resistance to phagocytosis and antibiotics. Photodynamic treatment (PDT) has been proposed as an alternative approach for the inactivation of bacteria in biofilms. In this study, we have investigated the effect of the photodynamic action of toluidine blue O (TBO) on the viability and structure of biofilms of Staphylococcus epidermidis and of a methicillin-resistant Staphylococcus aureus strain. Significant inactivation of cells was observed when staphylococcal biofilms were exposed to TBO and laser simultaneously. The effect was found to be light dose dependent. Confocal laser scanning microscopic study suggested damage to bacterial cell membranes in photodynamically treated biofilms. In addition, scanning electron microscopy provided direct evidence for the disruption of biofilm structure and a decrease in cell numbers in photodynamically treated biofilms. Furthermore, the treatment of biofilms with tetrasodium EDTA followed by PDT enhanced the photodynamic efficacy of TBO in S. epidermidis, but not in S. aureus, biofilms. The results suggest that photodynamic treatment may be a useful approach for the inactivation of staphylococcal biofilms adhering to solid surfaces of medical implants.
Photodynamic treatment of endodontic polymicrobial infection in vitro.


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We investigated the photodynamic effects of methylene blue on multispecies root canal biofilms comprising Actinomyces israelii, Fusobacterium nucleatum subspecies nucleatum, Porphyromonas gingivalis, and Prevotella intermedia in experimentally infected root canals of extracted human teeth in vitro. The 4 test microorganisms were detected in root canals by using DNA probes. Scanning electron microscopy showed the presence of biofilms in root canals before therapy. Root canal systems were incubated with methylene blue (25 microg/mL) for 10 minutes followed by exposure to red light at 665 nm with an energy fluence of 30 J/cm(2). Light was delivered from a diode laser via a 250-microm diameter polymethyl methacrylate optical fiber that uniformly distributed light over 360 degrees. Photodynamic therapy (PDT) achieved up to 80% reduction of colony-forming unit counts. We concluded that PDT can be an effective adjunct to standard endodontic antimicrobial treatment when the PDT parameters are optimized.
Photodynamic Therapy for Root Canals Infected with Enterococcus faecalis.

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Abstract 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.
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Background: The purpose of this study was to histometrically evaluate the influence of photodynamic therapy on bone loss in furcation areas in rats with experimentally induced periodontal disease. Methods: Ligatures were placed on the first mandibular molar in rats. Then the animals were divided into four groups: control group = no treatment; methylene blue group (MB) = treated topically with methylene blue (100 mug/ml); laser group (LLLT) = treated with low-level laser therapy; and photodynamic therapy group (PDT) = treated topically with MB followed by LLLT (4.5 J/cm(2)). Rats from all groups were sacrificed at 7, 15, or 30 days postoperatively. The area of bone loss in the furcation region of the first molar was histometrically analyzed. Data were analyzed statistically (analysis of variance and Bonferroni tests; P <0.05). Results: The PDT group demonstrated less bone loss compared to the other groups at 7 days (1.986 +/- 0.417 mm(2)); at 15 days, the PDT (1.641 +/- 0.115 mm(2)) and MB groups (1.991 +/- 0.294 mm(2)) demonstrated less bone loss compared to the control (4.062 +/- 0.416 mm(2)) and LLLT (2.641 +/- 0.849 mm(2)) groups. Conclusion: Within the parameters used in this study, PDT may be an effective alternative for control of bone loss in furcation areas in periodontitis.
Photodynamic effect of light-emitting diode light on cell growth inhibition induced by methylene blue.


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The aim of this study was to propose the use of red light-emitting diode (LED) as an alternative light source for methylene blue (MB) photosensitizing effect in photodynamic therapy (PDT). Its effectiveness was tested against Staphylococcus aureus (ATCC 26923), Escherichia coli (ATCC 26922), Candida albicans (ATCC 90028) and Artemia salina. The maximum absorption of the LED lamps was at a wavelength of 663 nm, at intensities of 2, 4, 6 and 12 J.cm-2 for 10, 20, 30 and 60 min of exposure, respectively. Assays with and without LED exposure were carried out in plates containing MB at concentrations of 7 to 140.8 (μ) M for microorganisms and 13.35 to 668.5 (μ) M for microorganisms or microcrustaceans. The LED exposure induced more than 93.05%, 93.7% and 93.33% of growth inhibition for concentrations of 42.2 (μ) M for S. aureus (D-value=12.05 min) and 35.2 (μ) M for E. coli (D-value=11.51 min) and C. albicans (D-value=12.18 min), respectively after 20 min of exposure. LED exposure for 1 h increased the cytotoxic effect of MB against A. salina from 27% to 75%. Red LED is a promising light device for PDT that can effectively inhibit bacteria, yeast and microcrustacean growth.

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Antimicrobial effects of photodynamic therapy on patients with necrotic pulps and periapical lesion.

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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 therapies 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 second total 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.
Photodynamic therapy in endodontic treatment of deciduous teeth.

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The purpose of this study was to evaluate photodynamic therapy in deciduous teeth with necrotic pulp by means of fully quantifying viable bacteria, before and after instrumentation and after the use of photodynamic therapy. Radicular canal cultures were conducted (n = 10): the first one was performed right after access and location of the radicular canal; the second was performed after the conclusion of chemical-mechanical instrumentation, and the last one after photodynamic therapy. The photodynamic therapy was performed with 4 J/cm energy low-intensity diode together with toluidine blue. The results (log(10)) were submitted to a descriptive analysis and Wilcoxon test. The percentage of reduction was submitted to the Mann-Whitney test. The instrumentation resulted in a reduction of 82.59% of viable bacteria, and, after photodynamic therapy, the microbial reduction observed was 98.37% (P = 0.0126). Photodynamic therapy is recommended as adjunct therapy for microbial reduction in deciduous teeth with necrotic pulp.

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This study evaluated the mechanisms involved and the influence of photosensitizer solvent in the killing of Enterococcus faecalis using photodynamic therapy (PDT). Enterococcus faecalis cells incubated with 100 mum methylene blue dissolved in water and in MIX (a mixture of glycerol:ethanol:water) were irradiated with 664 nm diode laser (63.69 J cm(-2)). The effect of PDT on the viability of bacteria, and the functional integrity of cell wall, chromosomal DNA and membrane proteins were analyzed. The bactericidal action of PDT was significantly higher when a MIX-based photosensitizer solvent was used (P < 0.001). Fluorimetric and fluorescence microscopy-based analysis showed the functional impairment of E. faecalis cell wall which was significantly higher when a MIX-based photosensitizer solvent was used (P < 0.001). PDT with MIX-based photosensitizer solvent showed extensive damage to chromosomal DNA. However, both PDT conditions showed similar trend in the degradation of membrane proteins, although cross-linked proteins were evident only in PDT conducted with MIX-based photosensitizer solvent. The findings from our study showed that PDT destroyed the functional integrity of cell wall, DNA and membrane proteins of E. faecalis. The degrees of damage on these targets were influenced by the photosensitizer solvent used during PDT.