DENTISTRY

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MICROBIOLOGICAL EFFICACY OF PHOTO-ACTIVATED DISINFECTION AND TEMPORARY ROOT OBTURATION AS AN ADJUNCT TO THE TREATMENT OF CHRONIC APICAL PERIODONTITIS

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Abstract: Photo-activated disinfection and temporary obturation are widely used in the treatment of apical periodontitis since effective elimination of microorganisms in infected root canal systems is an important concern for endodontics. The article presents results of microbiological research in the teeth with chronic apical peridontitis before and after the treatment.

KeyWords: photo-activated disinfection, temporary obturation, calcium hydroxide, microflora, chronic apical periodontitis.

INTRODUCTION

Photodynamic therapy (PDT), also called photoradiation therapy, phototherapy, or photochemotherapy was introduced into practice in 1904 as light-induced inactivation of cells, microorganisms, or molecules. PDT involves the combination of visible light, usually through the use of a diode laser and a photosensitizer.

The photosensitizer is a compound that is capable of absorbing light of a specific wavelength and transforming it into useful energy [1, 2]. Each factor is harmless by itself, but when combined they can produce lethal cytotoxic agents that can selectively destroy cells. Thus, PDT may represent a promising alternative for reducing the bacterial load or even for eradicating certain periodontal pathogens. PDT mechanism has been described by several authors. Briefly, upon illumination, the photosensitizer is excited from the ground state to the triplet state [3, 4].

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Materials and therapeutic agents containing calcium hydroxide are extensively used in a variety of treatment modalities within endodontics and dental traumatology [7, 8]. Calcium hydroxide in endodontics and dental traumatology makes antibacterial activity, antifungal activity, effect on bacterial biofilms, the synergism between calcium hydroxide and other agents, its effects on the properties of dentine, the diffusion of hydroxyl ions

The longer lifetime of the triplet state enables the interaction of the excited photosensitizer with the surrounding molecules, and it is generally accepted that generation of cytotoxic species produced during PDT occurs while in this state. The cytotoxic product, usually O2, cannot migrate over 0.02 mm after its formation, thus making it ideal for the local application of PDT without endangering distant molecules, cells, or organs [5]. PDT is widely used in the treatment of apical periodontitis, because effective elimination of microorganisms in infected root canal systems is an important concern in endodontics. PDT has recently been used to eradicate microorganisms from root canal systems, which suggests that it might be useful as adjunctive therapy to current endodontic disinfection techniques [6].

through dentine, and its toxicity [9, 10]. Combination of PDT and root temporary obturation with calcium hydroxide in endodontic treatment is not studied enough.

2 PURPOSES, SUBJECTS AND METHODS:

2.1 Purpose

To detect the content of microflora in the infected root canals with chronic apical periodontitis before and after photo-activated disinfection and temporary obturation.

2.2 Subjects

The study was performed at KNMU Dental Centre. The main group included 18 patients with chronic apical periodontitis aged 25-40.

2.3 Methods

PDT was used in addition to the standard root canal irrigation by 3% solution of Sodium hypochlorite. Photo-activated disinfection of root canals was performed by a photosensitizer, i.e. 10% povidone-iodine solution. Laser therapeutic device "Lika-terapevt M" with a wavelength = 810 nm was used as a light source. Photosensitizer solution remained in situ for 60 seconds, following which was activated by the laser for 120 seconds. The next stage of treatment involved temporary root obturation by calcium hydroxide paste for 10 days. After this period the paste was removed by handle instruments and 17% EDTA activated by ultrasound. Then root canals were dried with paper pins, standard and constant obturation and control X-ray to detect the quality of sealing.

Sampling of root canal content was performed with sterile paper pins 15 or 20 in size, and then transferred to the transport sterile environment Ames 10 ml. The material was delivered overnight to a microbiological laboratory for a quantitative bacteriological study using anaerobic cultivation technology. Quantitative planting of the material was carried out by the secretory Gold's method (1965). Identification of the microorganisms was performed using nutrient agar intended for their cultivation. Counting was made in colony-forming units (CFU).

Detection of pure cultures was conducted according to general bacteriological rules of research. The study was conducted twice: before treatment and before permanent obturation after all scheduled medical procedures.

Conflict of interests

There is no conflict of interests.

3 RESULTS AND DISCUSSION

Analysis of microbiological research of root canals content before treatment showed great variety of microorganisms. The study revealed thirteen type of bacteria and one type of fungus. A large number of identified microorganisms were gram-positive. According to the type of respiration there was obligate anaerobic and mixed type of respiration (facultative anaerobic and microaerophilic).

Root canals with chronic apical periodontitis were mainly found to contain Enterococcus faecalis, Staphylococcus epidermidis, Candida albicans, Pseudomonas aeruginosa and Escherichia coli. In 100% of cases the strains of Pseudomonas aeruginosa and Escherichia coli were cultured in patients undergoing repeated endodontic treatment (complications due to inadequate root canal fillings). Enterococcus faecalis, Staphylococcus epidermidis, Candida albicans, and bacteria of Streptococcus, Peptostreptococcus, Actinomyces, Lactobacillus were identified in cases of primary and secondary root canal treatment (table 1). After treatment the study identified Staphylococcus epidermidis, Streptococcus and bacteria of Pseudomonas aeruginosa in small concentrations (1.0 ± 0.01, 1.2 ± 0.02 and 1.1 ± 0.04 CFU/ ml respectively lg). Candida albicans, Enterococcus faecalis, Escherichia coli, Peptostreptococcus spp, Actinomyces spp., Lactobacillus spp. were not found in root canals. The difference between the data before and after treatment was statistically significant ($p < 0.05$).

Table 1.

Characteristics of microflora in root canals

Type of microorganism	Frequency before treatment, %	Concentration before treatment lg CFU/ml (M±m)	Frequency after PDT, %	Concentration after PDT lg CFU/ml (M±m)
Enterococcus faecalis	52.3	7.1±1.1	0	0
Staphylococcus epidermidis	43.5	5.5±0.9	25.5*	1.0±0.01*
Candida albicans	31.5	6.1±1.2	0	0
Pseudomonas aeruginosa	20.0	6.4±0.8	15.5*	1.2±0.02*
Escherichia coli	25.6	6.8±0.9	0	0
Streptococcus spp.	22.5	5.6±0.6	18.0*	1.1±0.04*
Pepto-?treptococcus spp.	6.5	5.5±0.5	0	0
Actinomyces spp.	5.0	4.4±0.8	0	0
Lactobacillus spp.	8.2	4.9 ±0.7	0	0

Note: * - statistically significant differences in the comparison of data before and after treatment, p <0.05

Comparison of microbial flora before and after treatment allowed us to develop its algorithm including temporary root obturation with calcium-hydroxide paste and photo-activated disinfection by 10% povidone-iodine, activated by 810 nm wavelength. This method of disinfection is undoubtedly advantaged by the dynamic irrigation promoting mechanical washing of microbic weight from root canals. A benefit of the photo-activated disinfection was its activity against pathogenic Enterococcus faecalis. Medicated treatment of root canals should begin with a dynamic irrigation of root chanals with sodium hypochlorite solution with the subsequent addition of photo-activated disinfection and temporary root obturation.

4 CONCLUSIONS

1. Root canals with chronic apical periodontitis were predominantly found to contain Enterococcus faecalis, Staphylococcus epidermidis, Candida albicans, Pseudomonas aeruginosa and Escherichia coli.

2. Enterococcus faecalis, bacteria of the genus Peptostreptococcus, Actinomyces and Lactobacillus were the least resistant to therapy.

3. Photo-activated disinfection of root canals with temporary root obturation is an effective method in treatment of chronic apical periodontitis, reducing the concentration of microbial cenoses to etiologically non-significant concentration.

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