MEDICAL SCIENCES

THE EFFECTIVENESS OF LASER TECHNOLOGIES IN THE TREATMENT OF GENERALIZED PERIODONTITIS

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Abstract

The effectiveness of the use of antimicrobial drugs for the treatment of generalized periodontal diseases has recently decreased due to the development of resistance of microorganisms. Photoactivated disinfection can be an effective addition to treatment and an alternative to antibacterial drugs. A system has been developed to optimize the procedure for photoactivated disinfection at the stage of professional hygiene. The technology of laser photometry for identifying microorganisms is being developed.

Keywords: generalized periodontitis, laser technologies, periodontopathogenic microflora.

Generalized periodontal diseases, despite significant scientific and technological progress and high achievements in medicine, currently still remain one of the most pressing problems in practical dentistry. A high incidence of periodontal pathology in the population is observed both in highly developed countries and in developing countries, which indicates a global level of the problem. In addition to the local process in the periodontium, the infectious component has a general effect on the body, which can lead to systemic diseases such as cardiovascular diseases, diabetes and adverse effects of pregnancy . One of the main causes of periodontal disease is dental plaque and the bacteria that colonize it. Combining into a system, bacterial cells form a microbial biofilm, which is a conglomerate of microorganisms attached to each other or to a specific surface, immersed in a matrix of extracellular polymeric substances and demonstrating a change in phenotype. Due to the complex structure of the biofilm, methods of influencing it are limited, and its successful elimination is of great importance in the management of generalized periodontal diseases [6]. SRP)) can be peeled off from the tooth surface, and microbial insemination can be reduced with antibacterial drugs [5]. However, mechanical cleaning cannot completely evacuate periodontopathogenic microflora; in addition, this treatment opens the dentinal tubules, which facilitates the penetration of microflora there and deeper infection . Recently, data have emerged on the acquisition of resistance of certain types of microorganisms to antiseptic preparations based on chlorhexidine bigluconate, which is widely used in periodontology. They show that long-term use of chlorhexidine can cause microflora resistance to certain antibacterial agents [11]. In 2014, an experiment was conducted in the USA, which consisted of taking samples of microbial biocenosis from periodontal pockets from 400 patients with generalized periodontitis with the onset of isolation and cultivation of periodontal pathogens, after which their resistance to such antibiotics was studied in vitro. and metronidazole. The following results were obtained: • In 74.2% of patients, periodontopathogens isolated were resistant to at least one of the antibiotics studied. , amoxicillin, metronidazole chiclindamycin in 55%, 43.3%, 30.3% and 26.5% of patients with generalized periodontitis, respectively. Thus, there is a tendency towards a condition in which the use of traditional therapy for periodontal diseases will eventually become ineffective, and it is worth considering new methods of influencing periodontal pathogenic microflora. We see such a new way of influencing pathogenic microflora in the use of photodynamic therapy (PDT). Since its inception, PDT has penetrated into many medical fields, including dentistry, where the term "PDT" is commonly understood as photoactivated disinfection (FAD) [2, 3]. cells in targets. These cells can be eukaryotic, non-plastic, or non-economic (prokaryotic) - such as bacteria. A photosensitive chemical, a photosensitizer, ideally should absorb light with wavelengths falling within the visible red and near-infrared nm), known as the "therapeutic window", where the deepest penetration of light into tissue is observed . A photosensitizer is a chemical compound that is easily photoexcited and then transfers its energy to other molecules. Typically, the photosensitizer transitions from the ground state (a quantum state with zero angular momentum spin) to an excited singlet state. It then undergoes an intersystem transition to a longer lasting triplet state. When a photosensitizer and an oxygen molecule are in close proximity to each other, a transfer of energy can occur that allows the photosensitizer to return to its original state, while the oxygen molecule in turn acquires an excited singlet state. This form of oxygen is a fairly aggressive chemical and reacts very quickly with any nearby biomolecules. As a consequence, cells that have reacted with active oxygen will die as a result of apoptosis or necrosis. These states can also be called reactive oxygen species. The most important element in selective photodynamic cytotoxicity is the first triplet (singlet) oxygen. When present in close proximity to the target cellular structure, it causes what is called oxidative stress—an imbalance between the production of reactive oxygen and the ability of the biological system to neutralize such reactive intermediates. This interaction is extremely fast, for example the reaction rate in water is 4 μs and 20 μs in cell membranes. The consequences of induced oxidative stress in target cells can be of the following types: - Cross-linking of cell membrane lipids. - Destruction of protein ion channels. - Destruction of critical metabolic enzymes. - Cell agglutination.

It has been demonstrated that the relative light required to inhibit bacteria using FAD is much less than the doses that are toxic to keratinocytes and fibroblasts. Also, some positive effects from the use of FAD were manifested in periodontal tissue cells, namely inhibition of inflammatory mediators, which promotes cellular chemotaxis and angiogenesis. The influence of FAD on neutrophils was revealed - promotion of their migration and integration was noted. FAD inhibits cytokines such as tumor necrosis factor and interleukin in certain ways. FAD attacks antigen-presenting cells such as macrophages and Langerhans cells, reducing their ability to activate T lymphocytes and attenuating the inflammatory response . Recent studies on the effectiveness of FAD showed that oral pathogenic species in planktonic solution were nearly as much as FAD and chlorhexidine, but in an ex vivo biofilm, FAD was more effective in inhibiting periodontal pathogens than chlorhexidine . Also in 2016–2017, a large-scale study of the effectiveness of photoactivated disinfection in the treatment of patients with cancer was conducted in the United States. The study took place in a group of patients that consisted of 141 people, divided into two cohorts. One cohort of patients underwent classical periodontal treatment (Scaling and RootPlaning), and the other added the use of FAD. A 0.01% solution of methylene blue was chosen as a photosensitizer, which was activated by a laser with a wavelength of 670 nm2. According to this study, the effectiveness of photoactivated disinfection using methylene blue for the treatment of generalized periodontal diseases was revealed, namely the treatment of periodontal pockets with laser radiation with a wavelength of 670 nM and a power of 225 mW [7], while previously conducted studies (2007 .) the effectiveness of using FAD in the treatment of aggressive forms of generalized periodontitis has not revealed a reliable method [19]. However, at present, FAD is still often used in clinical practice as an accompanying therapy for the treatment of severe forms of generalized periodontal diseases and reimplantitis. But we see that the use of photoactivated disinfection is not used to the full extent of its capabilities. Since at the stage of professional oral hygiene, mechanical destruction of the microbial biofilm occurs and its evacuation from the ash furrow or periodontal pocket outward from the accumulation sites, it becomes possible for microorganisms to migrate with oral fluid throughout the entire oral cavity. Eliminating this phenomenon with the help of antiseptics is difficult due to the fact that , as mentioned above, microorganisms in the biofilm are quite resistant to this factor and at the same time sensitive to the use of FAD.

Also, due to their physical properties, antiseptics cannot deeply penetrate the vernal sulcus or periodontal pocket, unlike laser radiation, especially with a wavelength of 660 nm. Therefore, we have developed a model for the use of photoactivated disinfection at the stage of professional oral hygiene, regardless of the presence of clinical manifestations of pathology. This, in turn, will help both in treating the disease in patients and in preventing it in clinically healthy people. A procedure protocol has been developed and a therapeutic complex has been manufactured, consisting of a laser emitter of a specially designed attachment, which will speed up the FAD process due to sector-by-sector irradiation of periodontal tissues and increase the ergonomics of the process. At the moment, the technology is at the stage of clinical trials [2, 3]. A fairly common problem nowadays is the identification of periodontopathogenic microflora, which is associated with the severity of cultivating anaerobic microorganisms, which are periodontopathogenic bacteria, and, for example, expensive research. as polymerase chain reaction (PCR). At the same time, data appeared in the literature [1] on the successful use of laser radiation to identify microorganisms of various species groups, as well as to assess the condition of body tissues. In particular, the laser conversion diagnostic method is used to identify microorganisms. It is based on the principle that when a sample is irradiated with light of a certain wavelength, the process of inelastic scattering of optical radiation on molecules of a substance (of any state of aggregation) occurs, accompanied by a noticeable change in the frequency of the radiation. This phenomenon is called the Raman effect or the Raman effect, which is recorded as a set of spectral lines that are absent in the spectrum of the primary (exciting) light.

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