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ОЦЕНКА ВЛИЯНИЯ УЛЬТРАФИОЛЕТОВОГО ОБЛУЧЕНИЯ НА ТКАНЕВУЮ МИКРОБИОТУ СЛИЗИСТОЙ ОБОЛОЧКИ АЛЬВЕОЛЯРНЫХ ОТРОСТКОВ У ПАЦИЕНТОВ ПЕРЕД УСТАНОВКОЙ ДЕНТАЛЬНЫХ ИМПЛАНТОВ

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ASSESSING THE EFFECT OF ULTRAVIOLET RADIATION ON THE MUCOSAL MICROBIOTA OF THE ALVEOLAR PROCESSES IN PATIENTS BEFORE DENTAL IMPLANTATION

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Резюме

Периимплантит является одним из наиболее частых осложнений при установке зубного импланта, возникающим не менее чем в 10-20% случаев. Основной причиной такого осложнения является образование биопленки бактериями, колонизирующими область установки импланта. Пусковым фактором развития таких состояний служит дисбиоз комменсальной флоры полости рта. Исследования показывают, что в норме в здоровой периимплантной борозде обнаруживают *Streptococcus* spp. в ассоциации с *Rothia* spp., *Neisseria* spp., *Corynebacterium* spp. Однако, *Streptococcus* spp. в ряде случаев являются индикаторными представителями микробиоты при развитии периимплантита. В процессе стоматологических манипуляций активно применяется ультрафиолетовое облучение (УФО). Целью исследования являлся анализ изменений в составе микробиоты слизистой оболочки альвеолярных отростков верхней и нижней челюстей под воздействием УФО. Исследованию подлежали биоптаты слизистой оболочки 35 пациентов, обратившихся с целью установки дентальных имплантов. От каждого пациента брали 2 образца слизистой. Один из образцов обрабатывали УФ облучателем «Солнышко», второй образец обработке УФО не подвергался. В результате исследования было идентифицировано 60 видов микроорганизмов. Все выявленные микроорганизмы были разделены на следующие группы: группа постоянной микробиоты, добавочной микробиоты, транзиторной микробиоты. Постоянную микробиоту как для образцов до обработки УФО, так и после, составили 2 вида стрептококков: *S. oralis, S. mitis*, после обработки УФО *S. vestibularis* и *S. salivarius* перешли в группу добавочной микробиоты, а *N. subflava* стала частью группы постоянной микробиоты. Наиболее широкое разнообразие микроорганизмов выявлено в транзиторной группе микробиоты. Среднее количество видов микроорганизмов на один образц изменилось с 9 ± 3 (M ± SD) в образцах без обработки УФО до 7 ± 3 (M ± SD) в образцах с обработкой. В образцах с обработкой УФО отмечается положительная тенденция изменения состава

микробиоты. Обработка периимплантационного поля УФО может приводить к снижению риска развития периимплантита, положительно влияет на характер изменения микробиоты ротовой полости, а именно ведет к снижению случаев выявления патогенных микроорганизмов.

Ключевые слова: тканевая микробиота, альвеолярные отростки, периимплантит, ультрафиолетовое облучение, дентальные импланты.

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Abstract

Peri-implantitis is one of the most common complications during dental implant installation, occuring in 10-20% cases. The main cause for such complication is the production of biofilms by bacteria colonizing the implant placement area. The triggering factor for this is dysbiosis of the commensal oral flora. Studies show that *Streptococcus* spp. in association with *Rothia* spp., *Neisseria* spp., *Corynebacterium* spp. is normally found in healthy peri-implant sulcus However, in some cases *Streptococcus* spp. are indicator microbiota representatives in developing peri-implantitis. Ultraviolet radiation (UV) has been actively used in dental manipulations. The aim of the study was to analyze changes in the mucosa microbiota composition in alveolar processes of the upper and lower jaws upon exposure to UV radiation. Biopsies of mucosa collected from 35 patients, applied for dental implantation, were examined. Two mucosal samples were obtained from each patient. One of either sample was treated with a "Solnyshko" UV irradiator, the second sample remained intact. As a result of the study, 60 species of microorganisms were identified divided into the following groups: the group of constant microbiota, additional microbiota, transient microbiota. The constant microbiota for both samples before and after UV treatment consisted of two *Streptococcus* species: *S. oralis* and *S. mitis*. After UV irradiation *S. vestibularis* and *S. salivarius* were moved into the group of additional microbiota, and *N. subflava* became part of constant microbiota. The widest diversity of microorganisms was found in the transient microbiota. The average number of microbial species per sample changed from 9 ± 3 (M ± SD) in samples without UV treatment to 7 ± 3 (M ± SD) in post-UV treatment samples. In the latter, microbiota composition tended to positively change. Treatment of the peri-implantation field with UV leads to lowered peri-implantitis risk, positively affects the pattern of changes in the oral microbiota, leads to reduced isolation of pathogenic microorganisms.

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Keywords: tissue microbiota, alveolar processes, peri-implantitis, ultraviolet radiation, dental implants.

1 Introduction

One of the most common methods of dental rehabilitation for patients with lost teeth is the installation of a dental implant. However, there are many factors that influence osseointegration [4]. Peri-implantitis is one of the most prevalent reasons of dental implant loss [6]. Despite the fact that patients undergo a comprehensive examination before implantation procedures, complications in the form of peri-implantitis occur in a range from 10 to 20% of cases. Such conditions are caused by the biofilms formation, which are produced by bacteria, colonizing the implant placement area. It is followed by impaired osseointegration and the emergence of an inflammatory reaction [12]. The triggering factor for such reaction is mainly a dysbiosis of the commensal oral flora [9]. Consequently, the research of the microbiological profile of the peri-implantitis' etiological factors determines the prevention and treatment tactics for these complications. A variety of studies shows that *Streptococcus* spp. is normally detected in a healthy peri-implant sulcus in association with *Rothia* spp., *Neisseria* spp., *Corynebacterium* spp. These microorganisms prevent excessive growth of various pathogens. However, *Streptococcus* spp. in some cases appear to be transitional or indicative representatives of the microbiota during the peri-implantitis emergence [8]. It is noted that the primary colonizers of the hard surfaces in the oral cavity are *Streptococcus* spp. (for example, *S. oralis*, *S. mutans*, *S. mitis*, *S. gordonii*, *S. sanguinis* and S. *parasanguinis*) as well as *Veillonella* spp., *Neisseria* spp., *Rothia* spp., *Abiotrophia* spp., *Gemella* spp. and *Granullicatella* spp. In later stages it is possible to isolate secondary colonizing flora, which is part of the red periodontopathogenic complex: *Porphyromonas gingivalis*, *Tannerella forsythia* and *Treponema denticola* [8, 7].

Ultraviolet radiation (UV) is actively used in dental manipulations [10, 13]. The rationale for the UV application in medical practice is associated with its bactericidal, anti-inflammatory, analgesic, epithelializing and regenerating properties [1]. UV applied to implant materials also showed positive results. On the

example of American prosthetists, it can be seen that under the influence of radiation, the ability of *Candida albicans* to form biofilms on poly(methyl methacrylate) decreased significantly [5].

The aim of the study is to analyze changes in the mucosal microbiota of the alveolar processes of the upper and lower jaws under the influence of UV.

2 **Materials and methods**

Biopsies of the mucosa of 35 patients applied for dental implantation were examined. A biopsy of the mucosa was taken using anatomical sterile tweezers and a disposable scalpel. The material was obtained by incision and exfoliation of the mucosa at the peri-implantation field. Two mucosal samples were taken from each patient. One of the samples was treated with a UV irradiator «Solnyshko» through a light guide (wavelength 250-300 nm, radiation power 100 MJ/cm2) at a distance of 2 cm during one minute. Each biopsy sample was placed in a sterile tube with Ames liquid medium and delivered to the laboratory.

Microbiological examination of biopsies was carried out using seven solid growth media: 5% blood agar, *Brucella*-agar, universal chromogenic agar, *Veillonella*-agar, *Clostridium*-agar, anaerobic agar and agar for lactobacilli. The tubes with the material were resuspended for one minute using a vortex mixer (V-1 plus, Vortex, Biosan). Sowing was performed with sterile disposable microbiological loops in «Bactron 300-2» anaerobic chamber with subsequent incubation for 4 days at a temperature of 37°C. Identification of all strains was carried out using MALDI-TOF mass spectrometry on a Microflex LT (Bruker, Germany). The statistical analysis was carried out using the StatTech program v.4.1.1 (StatTech LLC, Russia).

3 **Results**

As a result of the study, 60 species of microorganisms were identified. All identified microorganisms were divided into three groups. If the isolation of a microorganism from the samples occurred in more than 50% of cases, it was

assigned to the group of constant microbiota. If it was isolated in 25-50% of cases, microorganism was assigned to the group of additional microbiota. If it was isolated in less than 25% of cases, microorganism was regarded as a part of the transient microbiota. The distribution of microorganisms, isolated from samples without UV treatment, in aforementioned groups is shown in Figure 1. Similar distribution for samples treated with UV is shown in Figure 2.

For the samples without UV treatment, the constant microbiota consisted of 4 representatives of the *Streptococcus viridans* group (*S. oralis, S. mitis, S. salivarius, S. vestibularis*). However, during analysis of samples treated with UV, *S. vestibularis* and *S. salivarius* were assigned to the additional microbiota, and *Neisseria subflava* was transferred to the constant microbiota from additional microbiota.

For samples without UV treatment 8 microorganisms were included in additional microbiota: *S. anginosus, S. gordonii, S. parasanguinis, S. pneumoniae, Veillonella parvula, Neisseria subflava, Haemophilus parainfluenzae, Rothia mucilaginosa*. It is worth noting that *Streptococcus* spp. is a half of mentioned microorganisms. For samples treated with UV species composition of additional microbiota was found to be changed. This group of microbiota included such new microorganisms as *Streptococcus intermedius* and *Schaalia odontolytica*, which were moved from transient group. In opposite, *Streptococcus pneumoniae* and *Rothia mucilaginosa* were included in transient microbiota from additional group.

The widest microbial diversity was found in the transient microbiota. 36 species isolated from samples without UV treatment and 33 species isolated from the samples treated with UV were included in this group (Figures 1, 2). As it was written previously, for samples treated with UV *Schaalia odontolytica* and *Streptococcus intermedius* were moved from the transient microbiota to the additional, and some of the microorganisms were no more isolated. At the same time, the group of transient microbiota, isolated from samples with UV treatment, included 12 new bacterial species.

4 Discussion

Nowadays, the UV treatment method is widely used in medical practice and particularly in dentistry [11]. The preparation of the peri-implantation field implies the maximum possible reduction in the probability of implant infections, associated with various microorganisms. The purpose of our work was to analyze changes in the mucosal microbiota of the alveolar processes of the upper and lower jaws under the influence of UV radiation. Microbiological methods were used to examine 35 biopsies of the mucosa before UV treatment and 35 biopsies after UV treatment.

In total, 60 species of microorganisms were isolated and identified. All isolates were divided into three groups: constant, additional and transient microbiota. The average number of microbial species per sample changed from 9 ± 3 (M ± SD) in samples without UV treatment to 7 ± 3 (M ± SD) in samples with UV treatment.

The constant microbiota for samples both before and after UV treatment consisted of two *Streptococcus* spp. species: *S. oralis* and *S. mitis*. After UV treatment *S. vestibularis* and *S. salivarius* were transferred to the additional microbiota, and *N. subflava* became part of the constant microbiota.

In samples treated with UV radiation, there is a positive tendency in the microbiota composition. The isolation of individual pathogens, associated with the emergence of purulent-inflammatory processes in the oral cavity tissues, such as *S. pneumoniae, Staphylococcus aureus, Enterococcus faecalis, Klebsiella pneumoniae, Candida dubliniensis,* was found to be decreased. Isolation of *Streptococcus viridans* group had also decreased. At the same time, there was an increase in the isolation of *Lactobacillus paracasei, Ligilactobacillus salivarius and Limosilactobacillus oris,* which are associated with positive probiotic effect: stabilization of pH values, antagonism against pathogenic microorganisms and an effect on increase in IgA synthesis [2-3]. However, for some pathogens, in particular

S. mutans, which has an evident cariogenic effect, the treatment of UV samples did not significantly reduce the frequency of isolation.

Therefore, the treatment of the surgical field tissues with UV can lead to a decrease in the risk of peri-implantitis. It positively affects the changes in oral microbiota and leads to a decrease in the isolation of pathogenic microorganisms, including those with periodontopathogenic and cariogenic potential. It also increases the prevalence of microorganisms with probiotic effect.

РИСУНКИ

Figure 1. Distribution of microorganisms isolated from samples without UV treatment by groups.

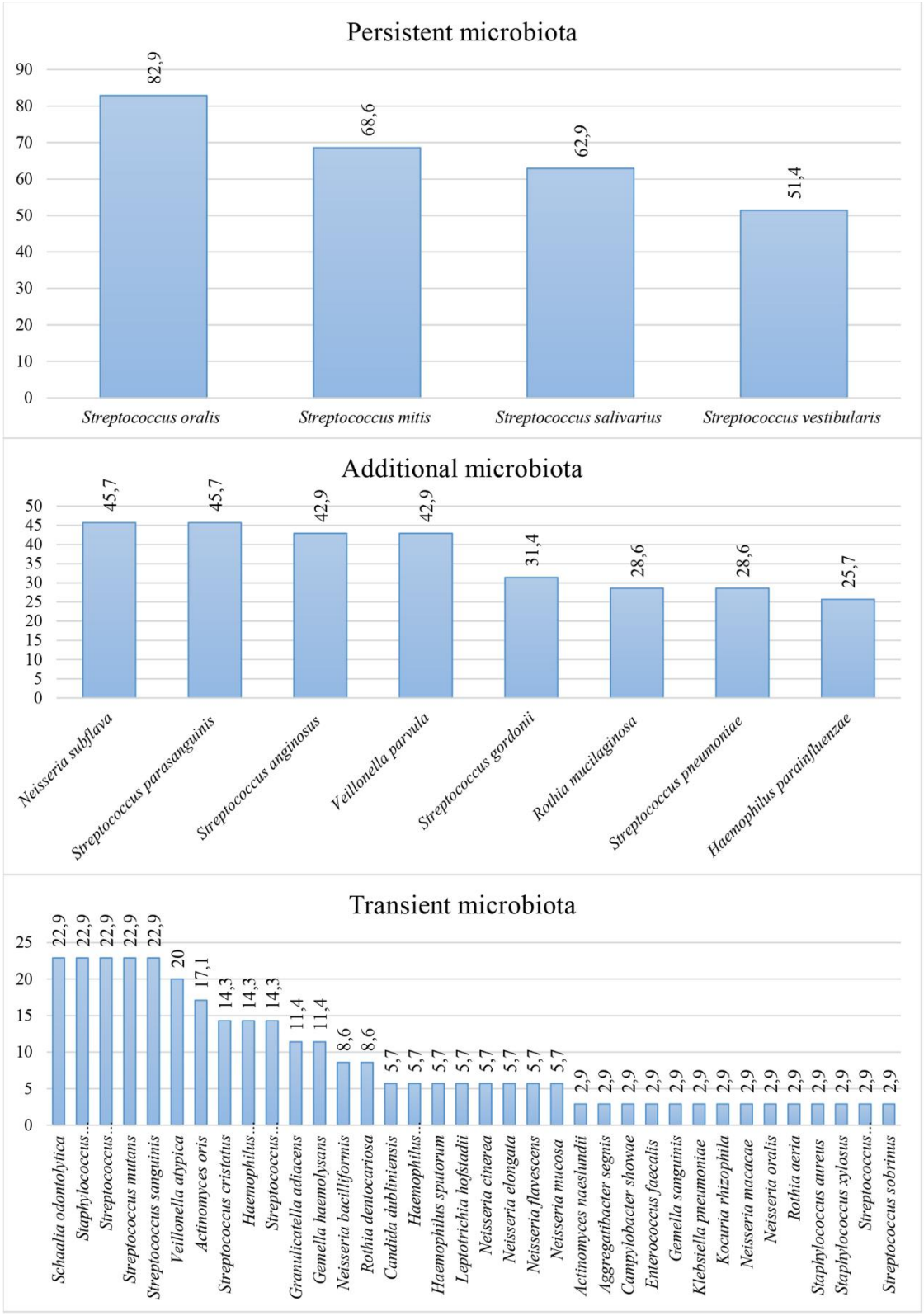
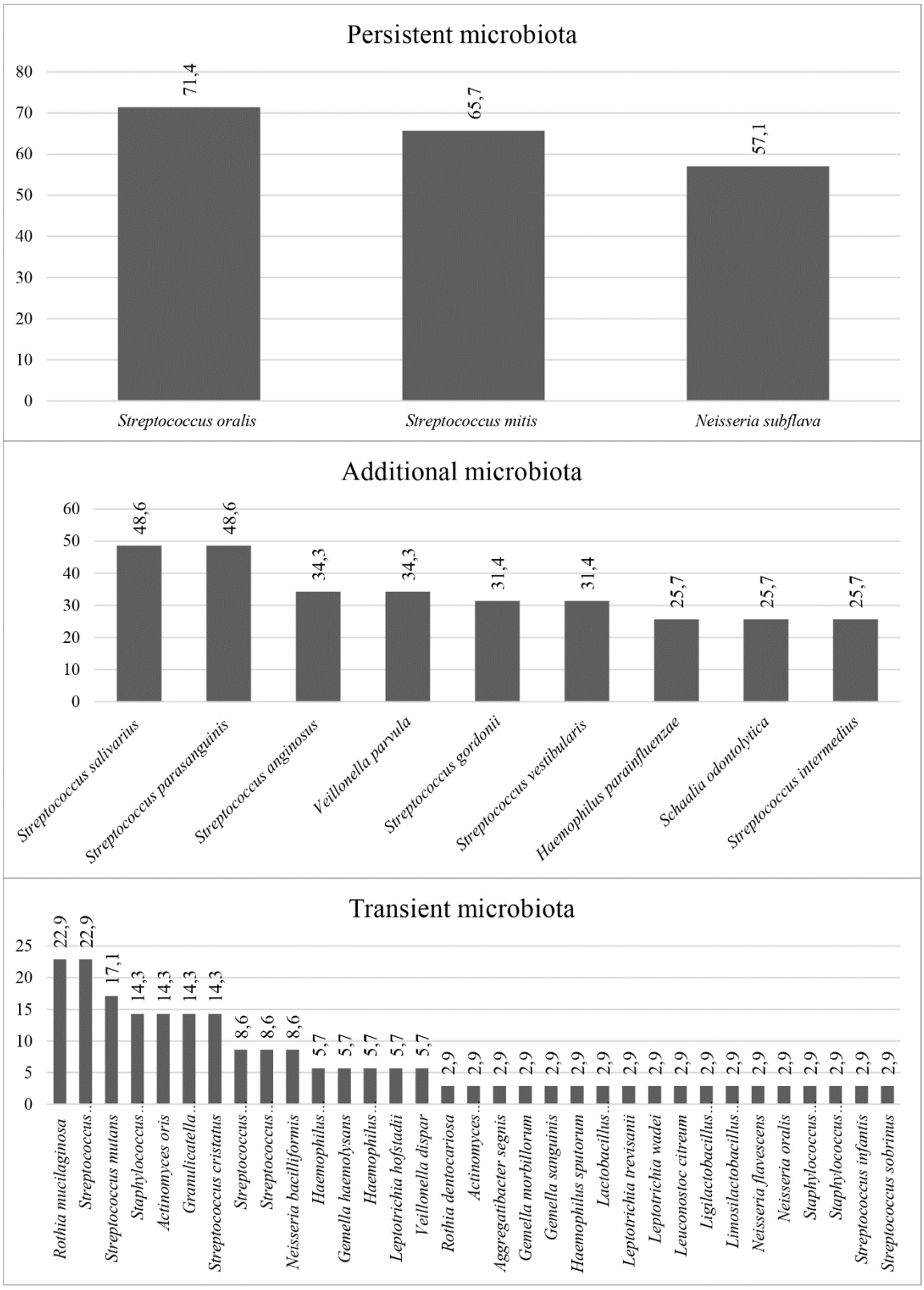


Figure 2. The distribution of microorganisms, isolated from samples with UV treatment by groups.



ТИТУЛЬНЫЙ ЛИСТ_МЕТАДАННЫЕ

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Блок 3. Метаданные статьи

ОЦЕНКА ВЛИЯНИЯ УЛЬТРАФИОЛЕТОВОГО ОБЛУЧЕНИЯ НА ТКАНЕВУЮ МИКРОБИОТУ СЛИЗИСТОЙ ОБОЛОЧКИ АЛЬВЕОЛЯРНЫХ ОТРОСТКОВ У ПАЦИЕНТОВ ПЕРЕД УСТАНОВКОЙ ДЕНТАЛЬНЫХ ИМПЛАНТОВ

ASSESSMENT OF THE EFFECT OF ULTRAVIOLET RADIATION ON THE MUCOSAL MICROBIOTA OF THE ALVEOLAR PROCESSES IN PATIENTS BEFORE DENTAL IMPLANTATION

Сокращенное название статьи для верхнего колонтитула:

ВОЗДЕЙСТВИЕ УФО НА МИКРОБИОТУ СЛИЗИСТЫХ ОБОЛОЧЕК
EFFECT OF UV ON MUCOSAL MICROBIOTA

Ключевые слова: тканевая микробиота, альвеолярные отростки, периимплантит, ультрафиолетовое облучение, дентальные импланты.

Keywords: tissue microbiota, alveolar processes, peri-implantitis, ultraviolet radiation, dental implants.

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