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Clinical and experimental substantiation of the effectiveness of non-pigmented laser photoablation in the treatment of peri-implantitis

Anastasia A. Zhekova, Andrey A. Chunikhin ✉, Ernest A. Bazikyan
Russian University of Medicine, Moscow, Russian Federation
✉ docca74@yandex.ru

Abstract
INTRODUCTION. In the treatment of peri-implantitis, it is important to significantly relieve inflammation in the peri-implant area, stop bone resorption and stimulate tissue regeneration. This is possible when using laser radiation with the effects of pigment-free laser photoablation.
AIM. Improving the effectiveness of peri-implantitis treatment using pigment-free laser photoablation.
MATERIALS AND METHODS. An experimental comparative study in 28 animals with model peri-implantitis under the influence of laser radiation with pigment-free photoablation and mechanical treatment of the peri-implant area in equal groups. Treatment of 70 patients with peri-implantitis in 2 equal groups of 35 patients – using pigment-free laser photoablation and mechanical treatment. In the groups, the immediate and remote results were assessed according to clinical signs. Before and after treatment, laboratory analysis of C-reactive protein, S-IgA and cortisol was performed.
RESULTS. Morphological analysis showed that the use of pigment-free laser photoablation helps to reduce inflammation and accelerate tissue regeneration. Clinical analysis showed high efficiency of pigment-free laser photoablation by 3.2 times compared to mechanical treatment. Analysis of laboratory research showed that the use of pigment-free laser photoablation helps to reduce CRP by 7.6, stimulate S-IgA by 1.2 times, stimulate cortisol by 1.3 times compared to traditional mechanical and drug treatment of peri-implant pockets.
CONCLUSIONS. Our experimental and clinical laboratory studies confirm the need to use pigment-free laser photoablation to improve the effectiveness of peri-implantitis treatment.

Keywords: peri-implantitis, non-pigmented laser photoablation, diode laser

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Клинико-экспериментальное обоснование эффективности применения беспигментной лазерной фотоабляции при лечении периимплантита

А.А. Жекова, А.А. Чунихин ✉, Э.А. Базикян
Российский университет медицины, г. Москва, Российская Федерация
✉ docca74@yandex.ru

Резюме
ВВЕДЕНИЕ. При лечении периимплантитов важным является значительное купирование воспаления в периимплантатной области, остановка резорбции костной ткани и стимуляция регенерации тканей. Такое возможно при использовании лазерного излучения с эффектами беспигментной лазерной фотоабляции.
ЦЕЛЬ. Повышение эффективности лечения периимплантитов с применением беспигментной лазерной фотоабляции.
МАТЕРИАЛЫ И МЕТОДЫ. Экспериментальное сравнительное исследование у 28 животных с модельным периимплантитом при воздействии лазерного излучения с беспигментной фотоабляцией и механической обработки перимплантатной зоны в равных группах. Проведение лечения 70 пациентов с перимплантитами в 2-х равных группах по 35 пациентов – с применением беспигментной лазерной фотоабляции и механической обработки. В группах оценивали ближайшие и отдаленные результаты по клиническим признакам. До лечения и в ближайшие сроки проводили лабораторный анализ С-реактивного белка, S-IgA и кортизола.
РЕЗУЛЬТАТЫ. Морфологический анализ показал, что применение беспигментной лазерной фотоабляции способствует снижению воспаления и ускорению регенерации тканей. Клинический анализ показал высокую эффективность беспигментной лазерной фотоабляции в 3,2 раза по сравнению с меха-

нической обработкой. Анализ лабораторного исследования показал, что применение беспигментной лазерной фотоабляции способствует снижению СРБ в 7,6, стимуляции S-IgA в 1,2 раза, стимуляции кортизола в 1,3 раза по сравнению с традиционной механической и медикаментозной обработкой периимплантатных карманов.
ВЫВОДЫ. Проведенные нами экспериментальные и клинико-лабораторные исследования подтверждают необходимость применения беспигментной лазерной фотоабляции для повышения эффективности лечения периимплантитов.

Ключевые слова: периимплантит, беспигментная лазерная фотоабляция, диодный лазер

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INTRODUCTION

Peri-implantitis is an inflammatory process that affects the soft tissues around the implant and leads to jawbone resorption [1; 2]. According to some researchers, the prevalence of peri-implantitis is 26.0% in patients with implants functioning for more than 5 years, and the incidence increases to 43.9% within 5 years, depending on risk factors [3]. An important goal of peri-implantitis treatment is to reduce inflammatory reactions, stop bone resorption or restore it in order to improve aesthetic results [4]. Most dentists treat peri-implantitis surgically or by curettage of pathological pockets [2; 5; 6]. However, the inability to completely remove granulation tissue devalues the results of surgical intervention. In addition, a key factor in the progression of peri-implantitis is non-compliance with oral hygiene measures, which patients often treat rather carelessly [2; 3; 8]. Laser technologies have recently been used for high-quality treatment of damaged tissues around the implant, which show a significant effect in removing inflammation products, decontaminating the implant surface and stimulating bone tissue regeneration [8; 9]. In this regard, the attention of researchers is drawn to diode laser systems with a wavelength of 1265 nm with modulation of nanosecond pulsed radiation [1; 6; 10]. Laser technologies are quite widely and effectively used in various fields of dentistry, including the treatment of inflammatory periodontal diseases [11; 12]. The diode laser provides the generation of singlet oxygen in tissues and non-pigmented photoablation, which helps stimulate reparative processes. Photoablation of epithelial tissue promotes gentle removal of pathological elements, effective decontamination, and also helps accelerate metabolism in soft and hard tissues due to the biostimulation effect [6].

AIM

Improving the effectiveness of peri-implantitis treatment using pigment-free laser photoablation.

MATERIALS AND METHODS

In the experimental part of the study, the effectiveness of non-pigmented laser photoablation and traditional mechanical and medicinal treatment of peri-implant pockets was assessed on the peri-implantitis model in experimental animals, New Zealand White rabbits, using morphological analysis. The studies were conducted in accordance with the national standard of the Russian Federation GOST R 53434-2009 “Principles of Good Laboratory Practice”. The study included 28 animals, which were divided into 2 equal groups. All animals received dental implants in the diastema between the incisors and molars on the lower jaw. After the osseointegration stage, after 90 days, peri-implantitis was modeled using a ligature wire, which was installed under the screw-cover for 30 days. Then, to obtain representative data, 2 animals from each group were removed from the experiment in order to conduct a morphological analysis to obtain evidence of obtaining a full-fledged peri-implantitis model. After this, we proceeded to the stage of exposure to the peri-implant zone in each group using various factors. In Group I, laser radiation from a diode laser with a wavelength of 1265 nm in a nanosecond pulsed radiation mode was used for exposure. In this case, we used an algorithm developed by us based on the study of previous studies and an empirical analysis of the destructive and biostimulating effects of laser radiation. The exposure algorithm was as follows: during the first procedure, contact treatment of the peri-implant pocket was performed using an optical fiber with a diameter of 400 nm and radiation parameters – pulse 50 ns, pause 500 ns, radiation power 2 W. The next procedure was performed 3 days later using a contactless method with a focal distance of 1–3 mm for 45 seconds at 4 (four) points medially and distally from the peri-implant zone from the vestibular and oral surfaces with the following parameters: pulse, 500 ns, pause 100 ns, power 5.0 W. The impact with such parameters was carried out every 3 days in the amount of 7 procedures for 21 days. In Group II, mechanical treatment of peri-implant pockets was carried out using curettes, and antiseptic treatment was also used. Animals in both groups were withdrawn from the experiment for morphological analysis on the 15th, 30th, 45th and 60th days of the experiment, 3 at each stage to obtain representative data.

The clinical part of the study included examination of 78 patients with peri-implantitis, 70 of whom were subsequently included in the study in accordance with the inclusion criteria developed by us, the main ones being

a peri-implant pocket depth of no more than 3.5 mm, no bone resorption around the implant of more than 1 mm, and no somatic pathology. All patients signed voluntary informed consent to participate in the clinical study and were randomly divided into two equal groups, each of which included 35 patients. In Group I, peri-implantitis was treated using pigment-free laser photoablation according to the algorithm developed by us, applied and tested in the experimental part of the study, in Group II, traditional mechanical and medicinal treatment of the peri-implant zone was used. To determine the clinical condition of the tissues of the peri-implant area, patients were invited for follow-up examinations on the 7th, 14th and 21st days after treatment and in the long-term periods of 6 and 12 months. Clinical assessment was carried out using the system we developed for the presence or absence of clinical signs using a scoring system. In the short term, the presence of such signs was assessed – edema, hyperemia, bleeding, in the long term, the clinical status was studied by the following signs – bleeding, pathological pocket, gingival recession.

In addition, to obtain data on inflammation and local immunity when using various methods of treating peri-implantitis, in the preoperative period and at the observation stages in the short term on the 7th, 14th and 21st days, a laboratory analysis of peri-implant fluid was performed for a quantitative study of C-reactive protein (CRP), secretory immunoglobulin A (S-IgA) and cortisol using enzyme immunoassay. All studies were approved by the Interuniversity Ethics Committee (protocol No. 02-21 dated 02/18/2021).

The obtained digital data were processed using the variation statistics method with the Student's T-test. The critical level of significance was considered reliable at $p < 0.05$.

RESULTS

According to the obtained data of the experimental study, using morphological analysis, it was proven that peri-implantitis was modeled in all animals after the installation of the ligature wire for 30 days. Morphological images showed inflammatory infiltration of the affected area by lymphocytes with the formation of abscesses and extensive hemorrhages (Fig. 1).

In Group I, using diode laser exposure, on the 60th day of observation, morphological analysis showed that the formation of fine bone tissue structures in the peri-implant zone was complete, and there were no inflammatory elements at all – lymphocytes and macrophages (Fig. 2).

In Group II, 60 days after the start of treatment of model peri-implantitis, foci of incomplete osteogenesis in the peri-implant zone are noted, as well as pronounced lymphocyte-macrophage infiltration (Fig. 3).

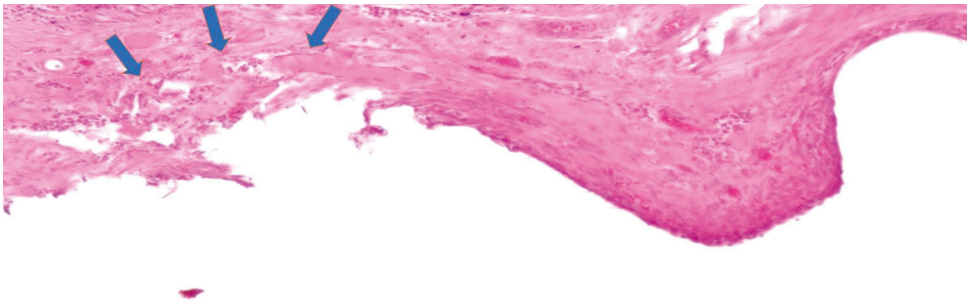

Fig. 1. Morphogram of peri-implant tissues after modeling peri-implantitis – inflammatory infiltration by lymphocytes (arrows) (hematoxylin-eosin, Zeiss, x50)

Рис. 1. Морфограмма периимплантатных тканей после моделирования периимплантита – воспалительная инфильтрация лимфоцитами (указано стрелками) (гематоксилин-эозин, Zeiss, x50)

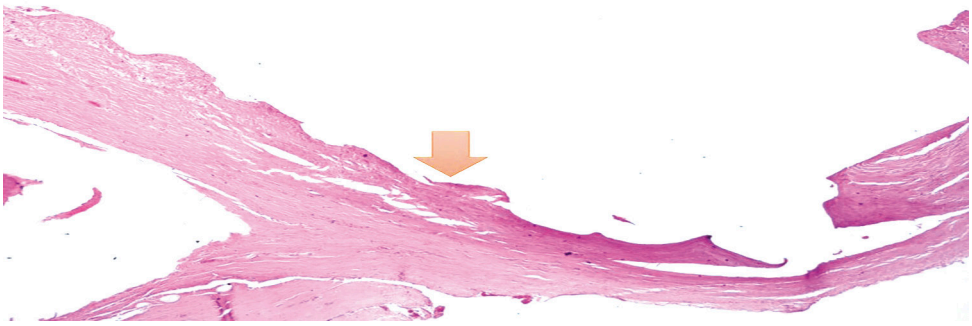

Fig. 2. Morphogram of peri-implant tissues in Group I on the 60th day of observation – implant bed (orange arrow) (hematoxylin and eosin, Zeiss, x100)

Рис. 2. Морфограмма периимплантатных тканей в группе I на 60-е сутки наблюдения – ложа имплантата (оранжевая стрелка) (гематоксилин-эозин, Zeiss, x100)

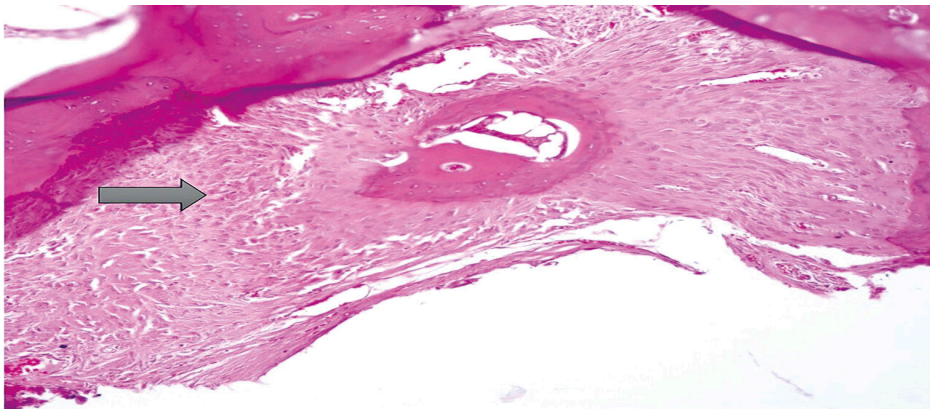

Fig. 3. Morphogram of peri-implant tissues in Group II on the 60th day of observation – fields of xanthomatous cells with pronounced hemorrhages (arrow) (hematoxylin and eosin, Zeiss, x200)

Рис. 3. Морфограмма периимплантатных тканей во II группе на 60-е сутки наблюдения – участки ксантоматозных клеток с выраженными кровоизлияниями (стрелка) (гематоксилин-эозин, Zeiss, x200)

Clinical analysis of the assessment of clinical signs in the immediate follow-up period showed that on the 21st day of observation after treatment in Group I, patients did not have any negative clinical signs. All 35 (100.0%) patients had completed tissue regeneration processes, no signs of edema, hyperemia or bleeding were detected. In Group II, after clinical examination, the result "excellent" was determined in 12 (34.3%) patients. In 11 (31.4%) patients, the result of peri-implantitis treatment in this group at the observation stage 21 days after treatment was determined as "good", with minor local hyperemia in some areas. The result "satisfactory" in this group was noted in 8 (22.9%) patients with minor manifestations of hyperemia and bleeding in some areas of the peri-implant zone. It should be noted that at the observation stage after 21 days, the result with the value "unsatisfactory" was noted as well as at the previous stage in 4 (11.4%) patients, in whom all negative clinical signs were detected – edema, hyperemia and bleeding in the peri-implant zone (Table 1). All the obtained results have a statistically significant difference ($p \leqslant 0.05$).

According to the results of laboratory analysis in the preoperative period, no statistically significant difference in the values of the studied parameters was revealed. At the same time, at the stages of treatment, significant fluctuations were noted in the levels of the studied factors of peri-implant fluid in different groups, reflecting the relationship between the treatment method and effectiveness. On the 7th day after the start of treatment in Group I, the CRP level was 1.5 times lower compared to Group II – 28.4±2.2 mg/l and 41.5±3.6 mg/l, respectively; on the 14th day of observation in Group I, a significant decrease in CRP was noted by 4.2 times compared to Group II – 7.3±0.9 mg/l and 30.8±3.1 mg/l; and on the 21st day of observation in Group I, a complete absence of inflammation was noted due to a decrease in CRP to normal values and 7.6 times lower compared to Group II – 2.5±0.4 mg/l and 18.9±2.0 mg/l (Fig. 4).

The level of secretory S-IgA on the 7th day of observation was increased by 1.2 times at 397.6±3.1 μg/ml and 321.2±2.8 μg/ml, respectively; on the 14th day, the increase in secretory immunoglobulin S-IgA by 1.2 times compared to Group II was maintained – 334.9±2.9 μg/ml and 283.1±2.5 μg/ml, respectively. The level of secretory immunoglobulin S-IgA also decreased by the 21st day compared to Group II by 2.3 times at 128.4±2.5 μg/ml and 301.2±2.8 μg/ml on the 21st day (Fig. 5).

Table 1. Results of clinical studies after treatment of peri-implantitis in different groups on the 21st day of observation

Таблица 1. Результаты клинических исследований после лечения периимплантита в различных группах на 21-е сутки наблюдения

Result	Group I	Group II
Excellent	35 (100.0%)	12 (34.3%)
Good	0 (0.0%)	11 (31.4%)
Satisfactory	0 (0.0%)	8 (22.9%)
Unsatisfactory	0 (0.0%)	4 (11.4%)

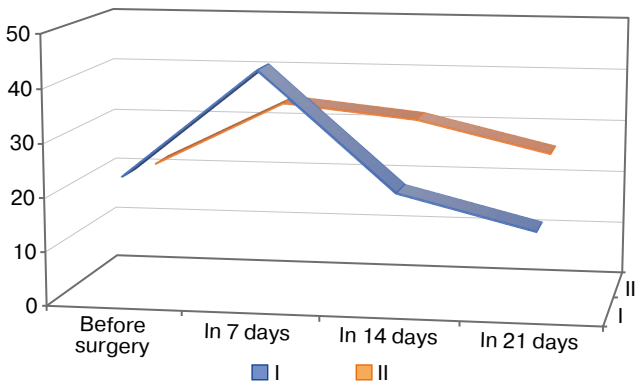

Fig. 4. Analysis of the CRP level in the preoperative period and at the observation stages in the near future (mg/l)

Рис. 4. Анализ уровня СРБ в предоперационном периоде и на этапах наблюдения в ближайшем будущем (мг/л)

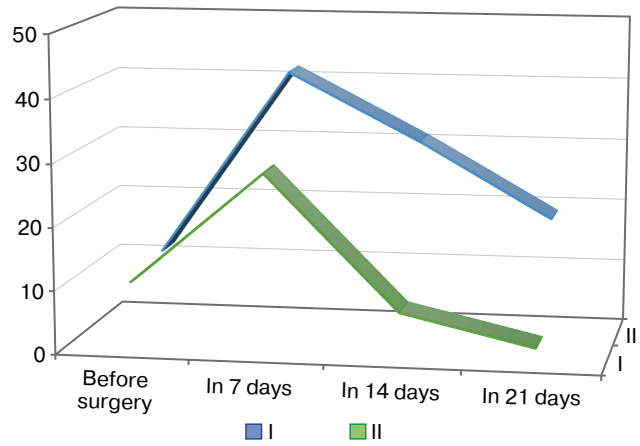

Fig. 5. Analysis of the level of secretory S-IgA in the preoperative period and at the observation stages in the near future (μg/ml)

Рис. 5. Анализ уровня секреторного S-IgA в предоперационном периоде и на этапах наблюдения в ближайшем будущем (мкг/мл)

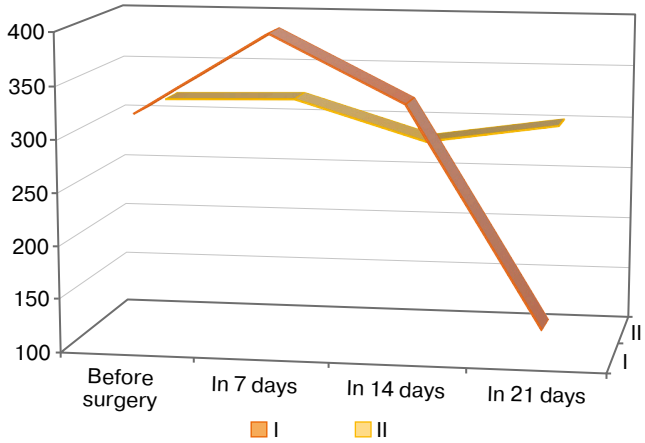

Fig. 6. Analysis of cortisol levels in the preoperative period and at the observation stages in the near future (nmol/l)

Рис. 6. Анализ уровня кортизола в предоперационном периоде и на этапах наблюдения в ближайшем будущем (нмоль/л)

The cortisol level on the 7th day was increased in Group I by 1.3 times compared to Group II – 43.4±2.1 nmol/l and 34.2±1.9 nmol/l, on the 14th day in Group I it decreased by 1.5 times compared to Group II – 21.6±1.9 nmol/l and 31.6±1.8 nmol/l, respectively, the cortisol level in the peri-implant fluid decreased by 1.7 times with the following average values in the groups – 15.3±1.5 nmol/l and 25.7±1.8 nmol/l, respectively (Fig. 6).

The results of clinical assessment of the peri-implant tissue condition 12 months after treatment showed "excellent" in Group I in 32 (91.4%) patients, which is 3.2 times higher compared to Group II, where the "excellent" result was noted in 10 (28.6%) patients. In 6 (17.1%) patients of this group, the result was noted as "good", in 12 (34.3%) as "satisfactory" and in 7 (20.0%) the result was noted as "unsatisfactory" in the presence of all negative signs – bleeding, pathological peri-implant pocket more than 3.5 mm deep and recession of the gingival margin in the peri-implant zone. In 2 cases, pronounced mobility of the implant was noted, which was decided to remove (Table 2).

Table 2. Results of clinical studies after treatment of peri-implantitis in different groups after 12 months

Таблица 2. Результаты клинических исследований после лечения периимплантита в различных группах через 12 месяцев

Result	Group I	Group II
Excellent	32 (91.4%)	10 (28.6%)
Good	3 (8.6%)	6 (17.1%)
Satisfactory	0 (0.0%)	12 (34.3%)
Unsatisfactory	0 (0.0%)	7 (20.0%)

DISCUSSION

As a result of the study, a new experimental model of peri-implantitis was obtained for use in studies on the therapeutic effect on soft and hard tissues during dental implantation [13]. The comparative morphological analysis showed that the use of pigment-free laser photoablation contributes to the completion of osteogenesis processes and the absence of inflammatory infiltration in the peri-implant zone. Based on the results of clinical observation in the immediate period after the treatment of peri-implantitis, it was proven that the use of the new technology of pigment-free laser photoablation contributes to a significant reduction in inflammation in the peri-implant zone, and also participates in stimulating the processes of tissue regeneration in the peri-implant area, which helps to increase the effectiveness of peri-implantitis treatment. The results of clinical observation in the long term after the treatment of peri-implantitis showed that the greatest treatment effectiveness is achieved in 91.4% when using pigment-free laser photoablation. The conducted analysis of the results of clinical studies in the treatment of peri-implantitis has proven that the effectiveness of pigment-free laser photoablation is 3.2 times higher compared to mechanical treatment. The results of laboratory studies prove the effect of pigment-free laser photoablation on local inflammatory factors and immune factors due to a decrease in CRP by 7.6 and stimulation of S-IgA by 1.2 times and cortisol by 1.3 times compared to traditional mechanical and medicinal treatment of peri-implant pockets. Based on the results of our clinical and laboratory study, a new method for the treatment of peri-implantitis using pigment-free laser photoablation was developed, which helps to reduce mechanical trauma, reduce inflammation, and stimulate tissue regeneration in the peri-implant area [14].

CONCLUSIONS

In an experimental study on animals, the effectiveness of pigment-free laser photoablation in the treatment of model peri-implantitis was proven using morphological analysis. The proposed method of pigment-free laser photoablation in the treatment of peri-implantitis allows for the effective removal of the pathological focus in the tissues surrounding the implant by ablation of the contents of granulation tissues, with simultaneous stimulation of bone tissue regeneration.

REFERENCES / СПИСОК ЛИТЕРАТУРЫ

1. Bazikyan E.A., Chunikhin A.A. Prospects of improvement of minimally invasive laser technologies in photodynamic therapy dental pathologies. *Russian Journal of Dentistry.* 2016;20(5):228–231. (In Russ.) Available at: https://rjdentistry.com/1728-2802/article/view/42038 (accessed: 02.10.2024).
   Базикян Э.А., Чунихин А.А. Малоинвазивные лазерные технологии на основе роботизированных мультифункциональных комплексов в челюстнолицевой хирургии и стоматологии. *Российский стоматологический журнал*. 2016;20(5):228–231. Режим доступа: https://rjdentistry.com/1728-2802/article/view/42038 (дата обращения: 02.10.2024).
2. Blinova A.V., Ryumshin R.A., Rumyantsev V.A. Periimplantitis – the basic complication of the dental implantation (literature review). *Upper Volga Medical Journal.* 2018;17(1):13–18. (In Russ.) Available at: http://medjournal.tvergma.ru/354/1/03.pdf (accessed: 02.10.2024).
   Блинова А.В., Рюмшин Р.А., Румянцев В.А. Периимплантит – основное осложнение дентальной имплантации (обзор литературы). *Верхневолжский медицинский журнал*. 2018;17(1):13–18. Режим доступа: http://medjournal.tvergma.ru/354/1/03.pdf (дата обращения: 02.10.2024).
3. Averyanov S.V., Gulyaeva O.A. Improving the effectiveness of conservative treatment of inflammatory complications after dental implantation. *Stomatologiya.* 2017;96(6-2):20. (In Russ.)
   Аверьянов С.В., Гуляева О.А. Повышение эффективности консервативного лечения воспалительных осложнений после дентальной имплантации. *Стоматология*. 2017;96(6-2):20.
4. Derks J., Ichioka Y., Dionigi C., Trullenque-Eriksson A., Berglundh J., Tomasi C., Graziani F. Prevention and management of peri-implant mucositis and peri-implantitis: A systematic review of outcome measures used in clinical studies in the last 10 years. *Clin Oral Implants Res*. 2023;34(Suppl. 25):55–67. https://doi.org/10.1111/clr.13925
5. Zhekova A.A., Bazikyan E.A., Ostrovskaya I.G., Chunikhin A.A., Klinovskaya A.S. Laser pigmentless photoablation as a new method for treating peri-implantitis. *Russian Journal of Stomatology.* 2023;16(3):58–59. (In Russ.)
   Жекова А.А., Базикян Э.А., Островская И.Г., Чунихин А.А., Клиновская А.С. Лазерная беспигментная фотоабляция как новый метод лечения периимплантита. *Российская стоматология*. 2023;16(3):58–59.
6. Sirak S.V., Didenko M.O., Sirak A.G., Shchetinina E.E., Sirak E.S., Pogozheva A.V. et al. Influence of load on modeling and remodeling of bone tissue in experimental perimplantitis. *Medical News of the North Caucasus.* 2020;15(3):364–368. (In Russ.) https://doi.org/10.14300/mnnc.2020.15086
   Сирак С.В., Диденко М.О., Сирак А.Г., Щетинина Е.Е., Сирак Е.С., Погожева А.В. и др. Влияние нагрузки на процессы моделирования и ремоделирования костной ткани при экспериментальном периимплантите. *Медицинский вестник Северного Кавказа*. 2020;15(3):364–368. https://doi.org/10.14300/mnnc.2020.15086
7. Chala M., Anagnostaki E., Mylona V., Chalas A., Parker S., Lynch E. Adjunctive use of lasers in peri-implant mucositis and peri-implantitis treatment: A systematic review. *Dent J*. 2020;8(3):68. https://doi.org/10.3390/dj8030068
8. Garunov M.M., Sevbitov A.V., Dolgalev A.A., Sirak S.V., Solovyeva O.A., Remizova A.A. et al. Clinical and radiographic assessment of osteointegration of dental implants after remodeling of the perimplant zone. *Medical News of the North Caucasus.* 2019;14(4):699–700. (In Russ.) https://doi.org/10.14300/mnnc.2019.14174
   Гарунов М.М., Севбитов А.В., Долгалев А.А., Сирак С.В., Соловьева О.А., Ремизова А.А. и др. Клинико-рентгенологическая оценка остеоинтеграции дентальных имплантатов после ремоделирования периимплантной зоны. *Медицинский вестник Северного Кавказа*. 2019;14(4):699–700. https://doi.org/10.14300/mnnc.2019.14174
9. Chunikhin A.A., Syrnikova N.V., Amirkhanova E.G. Comparative morphometric assessment of the effect of laser radiation on periodontal tissue regeneration in an in vivo experimental study. *Russian Journal of Stomatology.* 2020;13(1):47–49. (In Russ.)
   Чунихин А.А., Сырникова Н.В., Амирханова Е.Г. Сравнительная морфометрическая оценка влияния лазерного излучения на регенерацию тканей пародонта в экспериментальном исследовании in vivo. *Российская стоматология*. 2020;13(1):47–49.
10. Chobanyan A.G., Bazikyan E.A., Chunikhin A.A., Chobanyan A.G. Analysis of the effectiveness of the use of new laser technologies in conditions requiring accelerated remodeling of the jaw bone tissue. *Dental Forum.* 2023;(1):4–9. (In Russ.)
    Чобанян А.Г., Базикян Э.А., Чунихин А.А., Чобанян А.Г. Анализ эффективности применения новых лазерных технологий при состояниях, требующих ускорения ремоделирования костной ткани челюстей. *Dental Forum.* 2023;(1):4–9.
11. Chunikhin N.A., Sorokin I.O., Zima I.V., Bazikyan E.A., Chunikhin A.A. Clinical evaluation of the effectiveness of the treatment of chronic forms of periodontitis using transchannel laser non-pigmented photoablation. *Endodontics Today*. 2023;21(1):30–35. (In Russ.) https://doi.org/10.36377/1683-2981-2023-21-1-30-35
    Чунихин Н.А., Сорокин И.О., Зима И.В., Базикян Э.А., Чунихин А.А. Клиническая оценка эффективности лечения хронических форм периодонтитов с применением трансканальной лазерной беспигментной фотоабляции. *Эндодонтия Today*. 2023;21(1):30–35. https://doi.org/10.36377/1683-2981-2023-21-1-30-35
12. Postnikov M.A., Rozenbaum A.Yu., Chigarina S.E., Kudryashov D.N., Khaikin M.B., Khramova I.V., Belanov G.N. The effectiveness of antibacterial treatment of the root canal in chronic apical periodontitis using an erbium-chromium laser. *Endodontics Today*. 2022;20(2):115–120. (In Russ.) https://doi.org/10.36377/1726-7242-2022-20-2-115-120

Постников М.А., Розенбаум А.Ю., Чигарина С.Е., Кудряшов Д.Н., Хайкин М.Б., Храмова И.В., Беланов Г.Н. Эффективность антибактериальной обработки корневого канала при хроническом апикальном периодонтите с применением эрбий-хромового лазера. *Эндодонтия Today*. 2022;20(2):115–120. https://doi.org/10.36377/1726-7242-2022-20-2-115-120

13. Zhekova A.A., Chunikhin A.A., Yanushevich O.O., Bazikyan E.A., Gvetadze R.Sh. *Method for experimental simulation of peri-implantitis*. Russian Federation Patent for Invention No. RU 2821190 C1, date of filing: 07.08.2023, date of publication: 17.06.2024 (In Russ.) Available at: https://patenton.ru/patent/RU2821190C1 (accessed: 02.10.2024).
Жекова А.А., Чунихин А.А., Янушевич О.О., Базикян Э.А., Гветадзе Р.Ш. *Способ экспериментального моделирования периимплантита*. Патент на изобретение RU 2821190 C1, дата регистрации: 07.08.2023, дата публикации: 17.06.2024. Режим доступа: https://patenton.ru/patent/RU2821190C1 (дата обращения: 02.10.2024).
14. Zhekova A.A., Bazikyan E.A., Chunikhin A.A. Method of treating peri-implantitis using laser pigment-free photoablation. Russian Federation Patent for Invention No. RU 2809568 C1, date of filing: 13.12.2023, date of publication: 13.12.2023. (In Russ.) Available at: https://patents.google.com/patent/RU2809568C1/ru (accessed: 02.10.2024).
Жекова А.А., Базикян Э.А., Чунихин А. А. *Способ лечения периимплантитов с применением лазерной беспигментной фотоабляции*. Патент на изобретение RU 2809568 C1, дата регистрации: 13.12.2023, дата публикации: 13.12.2023. Режим доступа: https://patents.google.com/patent/RU2809568C1/ru (дата обращения: 02.10.2024).

INFORMATION ABOUT THE AUTHORS

Anastasia A. Zhekova – Assistant of the Department of Surgical Dentistry and Implantology of the N.D. Yushchuk Scientific Research Institute of Continuous Professional Education, Russian University of Medicine; 4, Dolgorukovskaya St., Moscow 127006, Russian Federation; https://orcid.org/0009-0007-6957-2743

Andrey A. Chunikhin – Dr. Sci. (Med.), Professor of the Department of Surgical Dentistry and Implantology of the N.D. Yushchuk Scientific Research Institute of Continuous Professional Education, Russian University of Medicine; 4, Dolgorukovskaya St., Moscow 127006, Russian Federation; https://orcid.org/0000-0002-9054-9464

Ernest A. Bazikyan – Honored Doctor of the Russian Federation, Dr. Sci. (Med.), Head of the Department of Surgical Dentistry and Implantology of the N.D. Yushchuk Scientific Research Institute of Continuous Professional Education, Russian University of Medicine; 4, Dolgorukovskaya St., Moscow 127006, Russian Federation; https://orcid.org/0000-0002-9184-3737

ИНФОРМАЦИЯ ОБ АВТОРАХ

Жекова Анастасия Ангеловна – ассистент кафедры хирургической стоматологии и имплантологии НОИ непрерывного профессионального образования имени Н.Д. Ющука, ФГБОУ ВО «Российский университет медицины»; 127006, Российская Федерация, г. Москва, ул. Долгоруковская, д. 4; https://orcid.org/0009-0007-6957-2743

Андрей Анатольевич Чунихин – доктор медицинских наук, профессор кафедры хирургической стоматологии и имплантологии НОИ непрерывного профессионального образования имени Н.Д. Ющука, ФГБОУ ВО «Российский университет медицины»; 127006, Российская Федерация, г. Москва, ул. Долгоруковская, д. 4; https://orcid.org/0000-0002-9054-9464

Эрнест Арамович Базикян – Заслуженный врач РФ, доктор медицинских наук, заведующий кафедрой хирургической стоматологии и имплантологии НОИ непрерывного профессионального образования имени Н.Д. Ющука, ФГБОУ ВО «Российский университет медицины»; 127006, Российская Федерация, г. Москва, ул. Долгоруковская, д. 4; https://orcid.org/0000-0002-9184-3737

AUTHOR'S CONTRIBUTION

Anastasia A. Zhekova – significant contribution to the concept and design of the study; conducting research, collecting and analyzing data, preparing the article.

Andrey A. Chunikhin – significant contribution to the concept and design of the study; preparing the article or critically revising it for significant intellectual content; collecting data, analyzing and interpreting data; final approval of the article for publication.

Ernest A. Bazikyan – preparing the article; critically revising the article for significant intellectual content; final approval of the article for publication.

ВКЛАД АВТОРОВ

А.А. Жекова – существенный вклад в замысел и дизайн исследования; проведение исследований, сбор и анализ данных, подготовка статьи.

А.А. Чунихин – существенный вклад в замысел и дизайн исследования; подготовка статьи или ее критический пересмотр в части значимого интеллектуального содержания; сбор данных, анализ и интерпретация данных; окончательное одобрение варианта статьи для опубликования.

Э.А. Базикян – подготовка статьи; критический пересмотр статьи в части значимого интеллектуального содержания; окончательное одобрение варианта статьи для опубликования.