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EXPERIENCE OF USING A DIODE LASER IN THE COMPLEX TREATMENT OF EARLY MANIFESTATIONS OF CHRONIC INFLAMMATION IN PERIODONTAL TISSUES

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Annotation

The article presents data on the effect of a low-intensity diode laser and applications of adhesive plates based on biogel in the treatment of initial manifestations of chronic inflammation in periodontal tissues. **Materials and methods.** 3 equal randomized groups of 35 patients each with manifestations of chronic inflammation in periodontal tissues were created. In accordance with the protocol of local treatment, all patients underwent a complex of professional oral hygiene and motivation to conduct individual hygiene. In the main clinical subgroups, patients additionally received laser therapy and applications of adhesive plates on the gum, or treatment according to clinical protocols of StAR, 2001. The quantitative assessment of the periodontal condition was carried out using OHI-S indices – SBI, PMA, GI, PI.

The aim of the study is to evaluate the change in hygienic and periodontal indices in patients with early manifestations of chronic inflammation in periodontal tissues after using laser therapy in combination with applications of adhesive plates based on biogel and methods of local treatment according to the clinical protocols of Dental Association of Russia, 2001. **Results.** A comparative evaluation of the effectiveness of the effect of a diode laser and applications of adhesive plates based on biogel and local treatment according to the clinical protocols of Dental Association of Russia, 2001 was confirmed by dynamic observation and monitoring of changes in reversible and irreversible indices. **Conclusions.** The observed qualitative decrease in indices in patients against the background of laser therapy and applications of adhesive plates based on biogel from the initial indicators was 8.2, 7.3 and 3.4 times for OHI-S, 7.2, 6.8 and 1.9 times for PMA, 5.9, 3.9, 2.6 times for SBI, 6.2, 4.5, 0.98 times for GI times, for PI 6,3,1 and 0.57 times ($p < 0.001$). In clinical subgroups, against the background of local treatment, according to the clinical protocols of Dental Association of Russia, 2001, the decrease in the index of OHY-S from the initial indicators occurred 3.3, 4.4, 1.8 times, for the PMA index 2.3, 4.5 times, for the SBI index 3.0, 2.6 times, for the GI index on average 2.1 times, for the PI index 2.5, 1.4 times, while its increase was observed in the subgroup with clinically intact periodontal disease by 6 months of dynamic follow-up and a decrease by 1.4 times by the year of follow-up ($p < 0.001$).

Keywords: *diode laser, gingivitis, periodontitis, hygiene indices, bleeding, dentoalveolar pocket, inflammation*

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ОПЫТ ИСПОЛЬЗОВАНИЯ ДИОДНОГО ЛАЗЕРА В КОМПЛЕКСНОМ ЛЕЧЕНИИ РАННИХ ПРОЯВЛЕНИЙ ХРОНИЧЕСКОГО ВОСПАЛЕНИЯ В ТКАНЯХ ПАРОДОНТА

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Аннотация

В статье представлены данные о влиянии низкоинтенсивного диодного лазера и аппликаций адгезивных пластин на основе биогеля в лечении начальных проявлений хронического воспаления в тканях пародонта. **Материалы и методы**. Путем проведения комплексного клинического обследования созданы три клинические группы с проявлениями начального хронического воспаления в тканях пародонта в зависимости от выявленного фактора риска — высоких или низких титров пародонтопатогенной микрофлоры. Лечебно-профилактические мероприятия включали лазеротерапию и аппликации адгезивных пластин на основе биогеля либо лечение согласно клиническим протоколам СтАР, 2001. **Цель исследования —** оценить изменение гигиенических и пародонтальных индексов у пациентов с ранними проявлениями хронического воспаления в тканях пародонта после использования лазеротерапии в комплексе с аппликациями адгезивных пластин на основе биогеля и методов местного лечения согласно клиническим протоколам СтАР, 2001. **Результаты.** Сравнительная оценка эффективности влияния лечебно-профилактических мероприятий подтверждена динамическим наблюдением и мониторингом изменения обратимых и необратимых индексов. **Выводы.** Наблюдаемое качественное снижение индексов у пациентов на фоне проведения лазеротерапии и аппликаций адгезивных пластин на основе биогеля от изначальных показателей составили для ИГР-У в 8,2, 7,3 и 3,4 раза, для PMA в 7,2, 6,8 и 1,9 раза, для SBI в 5,9, 3,9, 2,6 раза, для GI 6,2, 4,5, 0,98 раз, для PI 6,3,1 и 0,57 раз ($p < 0,001$). В клинических подгруппах на фоне местного лечения согласно клиническим протоколам СтАР снижение индекса ИГР-У от изначальных показателей произошло в 3,3, 4,4, 1,8 раза, для индекса PMA 2,3, 4,5 раза, для индекса SBI в 3,0, 2,6 раза, для индекса GI в среднем в 2,1 раза, для индекса PI в 2,5, 1,4 раза, при этом его повышение наблюдалось в подгруппе с клинически интактным пародонтом к 6 месяцу динамического наблюдения и снижение к году наблюдения в 1,4 раза ($p < 0,001$).

Ключевые слова: *диодный лазер, гингивит, пародонтит, индексы гигиены, кровоточивость, зубодесневой карман, воспаление*

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Inflammatory periodontal diseases are widespread among the world's population, including among people of young working age, which requires the development and implementation of the most effective methods of prevention, diagnosis and local treatment. It is known that in the development of the initial manifestations of chronic inflammation in periodontal tissues, as well as the state of their deterioration, a significant role is assigned to risk factors in the form of the presence of local, systemic, hereditary and external risk factors [2, 4, 8–11, 15, 23, 29].

Examination of patients with assessment of hygienic and periodontal status contributes not only to the early detection of manifestations of chronic inflammation in periodontal tissues, but also to their more visual objectification to the patient, which makes it possible to develop his correct motivation to carry out high-quality therapeutic and preventive measures, as well as to further maintain stable remission [10, 11, 16, 23, 28, 30].

Carrying out high-quality therapeutic and preventive measures in periodontal tissues can be carried out using the classical algorithm included in the clinical recommendations, but also the inclusion of laser technologies, which together contribute to a significant increase in the results of the treatment [1, 3, 13, 17, 18, 21, 22, 24–28, 30].

In the treatment of inflammatory periodontal diseases, methods of physiotherapy are increasingly used, including the use of lasers in the form of photodynamic therapy or semiconductor diode lasers. As it is known, the study of a red light stream by a diode laser has expressed anti-inflammatory, decongestant, bactericidal effects [5, 6, 7, 28, 30].

Despite the variety of modern lasers used in therapeutic dentistry, semiconductor diode lasers are the most effective in the modern aspect [12, 14].

Thus, the inclusion of a semiconductor diode laser and applications of adhesive plates based on biogel in the complex of local treatment of inflammatory diseases of periodontal tissues contributes to a significant increase in the effectiveness of therapeutic and preventive measures, more stable remission, which determined not only the relevance but also the purpose of our study.

The aim of the study was to evaluate the change in hygienic and periodontal indices in patients with early manifestations of chronic inflammation in periodontal tissues after the use of laser therapy in combination with applications of adhesive plates based on biogel and methods of local treatment according to the clinical protocols of Dental Association of Russia. The aim of the study is to assess the leveling of early signs of chronic inflammation in periodontal tissues based on a comparative study of the laser effect therapy in combination with applications of adhesive plates based on biogel and methods of local treatment according to clinical protocols.

Material and methods

By collecting complaints, anamnesis and objective examination, analysis of indicators of hygienic and periodontal indices, as well as the microbiological method of periodontopathogenic species of microorganisms detected in the composition of the supra- and subgingival biofilm made it possible to confirm the presence of chronic inflammation in periodontal tissues.

Depending on the data obtained, patients received various methods of local treatment of the initial manifestations of chronic inflammation in periodontal tissues with an assessment of their clinical effectiveness in the dynamics of the observation.

In accordance with the objectives of this study, all patients were randomized into two main clinical groups of 35 people each – I consisted of 35 people (33.3%) with diagnosed chronic generalized gingivitis (K05.10), II of 35 people (33.3%) with diagnosed chronic generalized periodontitis of mild severity (K05.3), the control group consisted of 35 patients (33.3%) with clinically intact periodontal disease (CIP).

In accordance with the objectives of this study, all patients were randomized into two clinical main groups of 35 people each, and a control group (35 patients).

The average age of the examined patients was 27,96 ± 5.04 years, while according to the criterion $\chi 2$ there were no differences in the distribution by sex and age ($p > 0.2$) (Table 1).

Table 1

Age and gender characteristics of patients with inflammatory periodontal diseases

Таблица 1. **Возрастные и гендерные особенности больных с воспалительными заболеваниями пародонта**

Age	*The number of examined patients in total number and in %*		*Gender attribute*			
			Men		*Women*	
	Total	*%*	*Total*	*%*	*Total*	*%*
20-24 years	35	33,3 $p > 0,2$	15	27,3 $p > 0,2$	20	36,4 $p > 0,2$
25-29 years	35	33,3 $p > 0,2$	20	36,4 $p > 0,2$	15	27,3 $p > 0,2$
30-35 years	35	33,3 $p > 0,2$	20	36,4 $p > 0,2$	15	27,3 $p > 0,2$

During an objective examination of the clinical condition, attention was paid to determining the color of gingival papillae, marginal gum and assessing the degree of prevalence and severity of inflammation. The index assessment included a simplified index of individual oral hygiene – OHI-S indices (Green–Vermillion index, 1964), the degree of inflammation in periodontal tissues based on the papillary-marginal-alveolar index PMA (Parma S., 1960), the index (SBI) according to Mulleman and Son (1971) was used to assess the bleeding of the gingival groove) in the modification of Cowell

(1975), the gingival index was used to determine the localization and severity of the inflammatory process in periodontal tissues — GI (Loe, silness, 1963), the degree of destructive changes in periodontal tissues was estimated based on the data of the periodontal index – PI according to Russel (WHO, 1956). Assessment of the condition of periodontal tissues was carried out using cone-beam computed tomography, bone density was estimated according to densitometry data in conventional units.The presence of bacterial cloud in the biofilm was possessed by PCR [2].

Clinical signs of the condition of periodontal tissues with the presence of a biological background including periodontopathogenic species made it possible to determine the presence of initial inflammation or gingivitis in patients with clinically intact periodontitis, to confirm the state of chronic inflammation in gingivitis (CG, K05.10) and periodontitis (Chronic generalized periodontitis of mild severity, K05.3). Clinical signs of chronic inflammation most often do not go beyond mucogingival junction, the presence of a dentoalveolar pocket is determined without loss of attachment.

Depending on the identified risk factor in the form of the presence of periodontopathogenic microflora, the main clinical groups and the control group were respectively divided into subgroups Ia (K05.10, n = 15), IIa (K05.3, n = 23), IIIa (KIP n = 8) with high titers and I (K05.10, n = 20), II (K05.3, n = 12), III (KIP n = 27) with low titers of periodontopathogenic microflora.

Therapeutic and preventive measures in clinical subgroups with low titers of periodontopathogenic microflora included a complex of local treatment according to the protocol of Dental Association of Russia 2001 – indication of microbial plaque, training in rational oral hygiene, professional oral hygiene (mechanical, ultrasonic removal of microbial plaque and Air Flow, with constant irrigation with 0.05% chlorhexidine solution), surface polishing teeth, local anti-inflammatory therapy, vitamin therapy.

In patients of the clinical subgroup with the presence of high titers of periodontal pathogenic microflora, professional oral hygiene and polishing of teeth «Er-Flo S2» were performed in one visit, followed by application of «Lamifaren» biogel to the inflamed gum area, the dentoalveolar groove or dentoalveolar pocket, from the vestibular and oral surfaces of the alveolar process in an amount of 0.1 ml/cm2 in on average for 25 minutes, after which the biogel was washed off with water and using a diode laser «RISASSO Lite» (on the therapeutic mode «red» spectrum, adjustable aiming beam 650-670 nm, radiation power – 0.3-0.7 W, intermittent mode), a single treatment of gingival papillae, dentoalveolar pockets from the vestibular and oral surfaces of the alveolar process was performed with a light guide with a cross-section of 400 microns. The irradiation time is 7 minutes for the area of one jaw, 15 minutes for the upper and lower jaws. The frequency of laser therapy with clinically intact periodontitis is 1 procedure, with chronic gingivitis and initial periodontitis, on average 2 procedures, with a repeat in a week.

At home, it was recommended to use adhesive plates based on Lamifaren biogel, by applying applications to the gum mucosa of the upper and lower jaws 2 times a day until complete dissolution. The course of local treatment with adhesive plates is 7 days for clinically intact periodontitis, 7 and 14 days for chronic gingivitis and initial periodontitis, respectively [20, 22].

Biogel based on kelp of the Far Eastern kelp (Angustata), contains fucoidan, polysaccharides, alginate, vitamins (A, C, D, B1, B2, B3, B6, B12, E, K, PP), polyunsaturated fatty acids (Omega-3), micro and macroelements. Fucoidan, which is part of the biogel, stimulates the production of b-lymphocytes and macrophages that destroy microbes and viruses, inhibits the development of allergic reactions. Alginic acids have immunomodulatory, regenerating, antimicrobial, antifungal, antiviral, antiallergic effects, have antioxidant, anticoagulant, hypotensive, hemostatic effects. Medical glycerin – increases the viscosity of liquid preparations and has pronounced antiseptic properties.

The adhesive plates developed by us provide the necessary physiological, tissue and intracellular metabolic processes due to the incoming micro- and macroelements: due to copper (Si), the synthesis of collagen and elastin occurs, due to magnesium (Mg), the normal course of redox reactions is ensured, normalization of iron metabolism (Fe) enhances oxygen transport, and redox reactions. This mechanism of local action on periodontal tissues as a whole is of no small importance in the complex of local treatment of inflammatory periodontal diseases with the presence of high titers of periodontopathogenic microorganisms.

The evaluation of the clinical efficacy of the local treatment of the detected chronic inflammation, depending on the composition of the supra- and subgingival biofilm, was carried out on the basis of dynamic observation of patients after 2 weeks, after 6 and 12 months.

To check for differences in the dynamics of the studied indicators before and after the therapeutic and preventive measures compared with the baseline level, the Wilcoxon test with a null hypothesis about the difference in differences was used. The Man-Whitney criterion was used to assess the intergroup differences in indicators. The differences obtained were considered significant at $p < 0.05$.

Research results and discussion

The initial indicators of the condition of periodontal tissues in all observed patients before the therapeutic and preventive measures correspond to the revealed presence of chronic inflammation, bleeding symptoms, gingival pocket and violations of the hygienic condition of the oral cavity. Microbiological methods have confirmed the

presence of a risk of their development in the form of the presence of low or high titers of periodontopathogenic microflora. The revealed changes made it possible to correctly assess the clinical condition of periodontal tissues and, depending on this, allowed the choice of a treatment method (Table 2).

Periodontal treatment with a diode laser in combination with applications of adhesive plates based on biogel contributes to a more significant reduction in the degree of chronic inflammation, a decrease in the depth of the gingival pocket, a decrease in bleeding of the gingival groove and normalization of the hygienic condition of the oral cavity in the dynamics of the entire period of clinical observation, compared with subgroups treated according to the clinical protocol (Table 3–5).

In the clinical subgroup of people with chronic gingivitis (K 05.10), the effect of laser therapy contributed to qualitative changes in indices immediately after local treatment and in the dynamics of observation.

For all the indices considered in the subgroup of people with chronic gingivitis (K05.10), a statistical difference was noted at a significance level of $p < 0.01$, the exception was only sulcus bleeding index (SBI) according to Mulleman and Son in the Cowell modification for subgroup I patients 2 weeks after treatment according to clinical protocols, of StAR, 2001, a statistically significant difference at $p < 0.05$ was not achieved. Intergroup comparisons conducted according to the Man-Whitney criterion showed differences in the initial levels of a number of indices (OHI-S, PMA, PI) against the background of laser therapy (I subgroup K05.10) at $p < 0.05$, for OHI-S after 2 weeks and after 12 months, for GI (after 2 weeks and lasting up to a year) and for PI (after 12 months). The initial value of the state of the index of OHI-S in the observed patients with the presence of chronic gingivitis, regardless of the treatment method, of local treatment, corresponds to a satisfactory criterion. A good condition according to the OHI-S index was observed by the end of the entire dynamic observation, with a slight difference in the index values between I and I a clinical subgroups (Table 3).

In the dynamics of the treatment, there is a clear tendency to improve not only the clinical but also the hygienic condition of the oral cavity of all patients with the presence of initial periodontitis (II and II-a subgroup K05.3), however, the influence of a diode laser (subgroup IIa) contributes to a more pronounced stabilization of indices, including the gingival Sulcus bleeding index (SBI) compared to the subgroup data on the background of treatment according to the clinical protocol StAR, 2001.

All the indices considered in the II and III clinical subgroup of patients (K05.3) statistically significantly differed after 2 weeks, 6 and 12 months, regardless of the method of treatment, from the values of the baseline level at the significance level $p < 0.001$. Before carrying out qualitative therapeutic measures, the values of hygienic and periodontal indices in clinical subgroup II and II a of patients (K05.3) with a low titer of periodontopathogenic microflora and with a high titer of periodontopathogenic microflora did not differ ($p > 0.2$).

However, in the dynamics of clinical observation after 2 weeks, six months and 12 months for all indices, there was a statistically significant difference in indicators in clinical subgroup IIa against the background of laser therapy and the use of adhesive plates based on biogep < 0.05 (Table 4).

In the control subgroup of individuals with clinically intact periodontal disease (III) and detected initial inflammation (III a), depending on the method of treatment,

Table 2

Initial indicators of the index assessment of the periodontal tissues clinical condition in the examined patients, depending on the identified risk factor

Таблица 2. **Исходные показатели индексной оценки клинического состояния тканей пародонта у обследованных пациентов в зависимости от выявленного фактора риска**

Clinical subgroup	*Hygienic and periodontal indices*				
	OHI-S	*PMA*	*SBI*	*GI*	*PI*
I subgroup CG (K 05.10, n = 20) with a low titer of periodontopathogenic microflora	1,75 ± 0,19 p = 0,006	15,3 ± 2,23 p = 0,001	1,08 ± 0,22 p = 0,098	1,43 ± 0,24 p = 0,166	0,85 ± 0,13 p = 0,209
I subgroup CG (K 05.10, n = 15) with a high titer of periodontopathogenic microflora	1,57 ± 0,18 *p* = 0,006	29,8 ± 3,03 p = 0,001	1,48 ± 0,21 p = 0,098	1,99 ± 0,31 p = 0,166	1,02 ± 0,14 p = 0,209
II subgroup Chronic generalized periodontitis of mild severity (K 05.3, n = 12)) with a low titer of periodontopathogenic microflora	2,72 ± 0,31 p = 0,396	46,94 ± 3,34 p = 0,201	1,75 ± 0,25 p = 0,415	2,1 ± 0,21 p = 0,228	1,32 ± 0,15 p = 0,415
II-a subgroup Chronic generalized periodontitis of mild severity (K 05.3, n = 23) with a high titer of periodontopathogenic microflora	2,92 ± 0,34 p = 0,396	49,3 ± 2,32 p = 0,201	1,85 ± 0,15 p = 0,415	2,6 ± 0,31 p = 0,228	1,52 ± 0,18 p = 0,415
III-control subgroup CG (n = 27) with a low titer of periodontopathogenic microflora	0,77 ± 0,15 p = 0,001	0 p = 0,001	0 p = 0,001	0 p = 0,001	0 p = 0,001
IIIa- control subgroup CG (n = 8) with a low titer of periodontopathogenic microflora	1,57 ± 0,08 p = 0,001	10,7 ± 2,51 p < 0,001	0,65 ± 0,15 p < 0,001	0,98 ± 0,04 p < 0,001	0,57 ± 0,08 p < 0,001

there was an improvement in all studied indices and the clinical condition of the periodontal, while a more significant change was noted by us in the subgroup with the use of a diode laser. The change in the OHI-S Hygiene index as a result of the influence of laser therapy significantly differed from the baseline level before treatment (at $p < 0.001$), while no significant differences were achieved in the III clinical subgroup against the background of treatment according to the clinical protocol StAR, 2001., compared with the baseline level (Table 5).

Conclusion

At the initial manifestations of inflammation in periodontal tissues caused by high titers of periodontopathogenic microflora, the effect of a diode laser in combination with applications of adhesive plates based on biogel contributed to a significant decrease in hygienic and periodontal indices. The dynamics of the decrease in the value of the OHI-S index from the initial indicators averaged 8.2, 7.3 and 3.4 times, for the PMA index 7.2, 6.8 and 1.9 times, for the SBI index 5.9, 3.9, 2.6 times, for the GI index 6.2, 4.5, 0.98 times and for the PI index 6,3.1 and 0.57 times ($p < 0.001$).

The complex of local treatment of the initial manifestations of chronic inflammation in periodontal tissues caused by low titers of periodontopathogenic microflora according to the clinical protocols of Dental Association of Russia, 2001. also contributed to a decrease in the

Table 3

Changes in clinical parameters in patients with chronic gingivitis (K05.10) depending on the treatment method of local treatment

Таблица 3. **Изменения клинических показателей у больных хроническим гингивитом (K05.10) в зависимости от метода местного лечения**

Index indicators	*I subgroup of CG(n = 20) with a low titer of periodontopathogenic microflora and with local treatment according to the StAR protocol, 2001*	*I a is a subgroup of CG (n = 15) with a high titer of periodontopathogenic microflora with the proposed complex of local treatment*	*Intergroup comparison*
Simplified index of oral Hygiene OHI-S (Green–Vermillion Index, 1964)			
before treatment	1,75 ± 0,19	2,57 ± 0,21$^{\#}$	p = 0,006
after 2 weeks	1,07 ± 0,17**, p = 0,007	1,57 ± 0,18***, p < 0,001	p = 0,137
after 6 months	0,37 ± 0,14***, p < 0,001	0,24 ± 0,09***, p < 0,001	p = 0,223
after 12 months	0,52 ± 0,11***, p < 0,001	0,21 ± 0,07***, p < 0,001	p = 0,121
Papillary-marginal-alveolar index PMA (Parma S., 1960)			
before treatment	15,3 ± 2,23	29,8 ± 3,03$^{\#\#\#}$	p < 0,001
after 2 weeks	5,25 ± 1,08***, p < 0,001	0$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 6 months	7,14 ± 1,33***, p < 0,001	6,60 ± 1,54***, p < 0,001	p = 0,134
after 12 months	6,60 ± 1,12***, p < 0,001	4,17 ± 0,58***, p < 0,001	p = 0,031
Sulcus bleeding index (SBI) according to Mulleman and Son (1971) in the Cowell modification (1975)			
before treatment	1,08 ± 0,22	1,48 ± 0,21	p = 0,098
after 2 weeks	0,77 ± 0,11, p = 0,061	0***, p < 0,001	p = 0,437
after 6 months	0,57 ± 0,14*, p = 0,011	0,37 ± 0,11***, p < 0,001	p = 0,107
after 12 months	0,35 ± 0,13**, p = 0,002	0,25 ± 0,13***, p < 0,001	p = 0,217
Determination of the gingival index — GI (Loe, silness, 1963)			
before treatment	1,43 ± 0,24	1,99 ± 0,31	p = 0,166
after 2 weeks	0,48 ± 0,04***, p < 0,001	0,81 ± 0,11$^{***,\#\#}$, p < 0,001	p = 0,007
after 6 months	0,78 ± 0,14**, p = 0,002	0,40 ± 0,08$^{***,\#}$, p < 0,001	p = 0,033
after 12 months	0,66 ± 0,12***, p < 0,001	0,32 ± 0,09$^{***,\#}$, p < 0,001	p = 0,039
Periodontal index - (PI) according to Russel (WHO, 1956)			
before treatment	0,85 ± 0,13	1,02 ± 0,14	p = 0,209
after 2 weeks	0,17 ± 0,08***, p < 0,001	0***, p < 0,001	p = 0,177
after 6 months	0,45 ± 0,07**, p = 0,006	0,23 ± 0,05***, p < 0,001	p = 0,106
after 12 months	0,34 ± 0,03***, p < 0,001	0,17 ± 0,07$^{***,\#}$, p < 0,001	p = 0,046

#, ##, ### – intergroup differences according to the Mann-Whitney test, respectively, at a significance level of $p < 0.05$, $p < 0.01$ and $p < 0.001$

,, *** – the significance of differences in indicators compared to the initial value before treatment at $p < 0.05$, $p < 0.01$ and $p < 0.001$, respectively (according to the Wilcoxon test)*

Table 4

Changes in clinical parameters in persons with chronic generalized periodontitis of mild severity (K05.3) depending on the method of local treatment

Таблица 4. **Изменения клинических показателей у лиц с хроническим генерализованным пародонтитом легкой степени тяжести (K05.3) в зависимости от метода местного лечения**

Index indicators	*II subgroup with chronic generalized periodontitis of mild severity (n = 12) with a low titer of periodontopathogenic microflora and with local treatment according to the StAR protocol, 2001*	*II a- subgroup group with chronic generalized periodontitis of mild severity (n = 23) with a high titer of periodontopathogenic microflora with the proposed complex of local treatment*	*Intergroup comparison*
Simplified index of oral Hygiene OHI-S (Green–Vermillion Index, 1964)			
before treatment	2,72 ± 0,31	2,92 ± 0,34	p = 0,396
after 2 weeks	0,78 ± 0,15***, p < 0,001	0,40 ± 0,08$^{***,\#}$, p < 0,001	p = 0,047
after 6 months	0,58 ± 0,11***, p < 0,001	0,42 ± 0,08***, p < 0,001	p = 0,104
after 12 months	0,62 ± 0,08***, p < 0,001	0,40 ± 0,07***, p < 0,001	p = 0,097
Papillary-marginal-alveolar index PMA (Parma S., 1960)			
before treatment	46,94 ± 3,34	49,3 ± 2,32	p = 0,201
after 2 weeks	18,15 ± 1,53***, p < 0,001	5,15 ± 2,33$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 6 months	7,17 ± 0,93***, p < 0,001	6,13 ± 0,74***, p < 0,001	p = 0,112
after 12 months	10,48 ± 1,03***, p < 0,001	7,23 ± 0,65$^{***,\#\#\#}$, p < 0,001	p < 0,001
Sulcus bleeding index (SBI) according to Mulleman and Son (1971) in the Cowell modification (1975)			
before treatment	1,75 ± 0,25	1,85 ± 0,15	p = 0,415
after 2 weeks	1,03 ± 0,11**, p = 0,005	0,38 ± 0,05$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 6 months	0,78 ± 0,05***, p < 0,001	0,56 ± 0,05$^{***,\#}$, p < 0,001	p = 0,042
after 12 months	0,68 ± 0,05***, p < 0,001	0,48 ± 0,05$^{***,\#}$, p < 0,001	p = 0,048
Determination of the gingival index — GI (Loe, silness, 1963)			
before treatment	2,1 ± 0,21	2,6 ± 0,31	p = 0,228
after 2 weeks	0,78 ± 0,14***, p < 0,001	0$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 6 months	0,77 ± 0,09***, p < 0,001	0,55 ± 0,04***, p < 0,001	p = 0,119
after 12 months	0,98 ± 0,17***, p < 0,001	0,58 ± 0,14***, p < 0,001	p = 0,078
Periodontal index - (PI) according to Russel (WHO, 1956)			
before treatment	1,32 ± 0,15	1,52 ± 0,18	p = 0,415
after 2 weeks	0,87 ± 0,09*, p = 0,011	0$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 6 months	0,57 ± 0,08***, p < 0,001	0$^{***,\#\#\#}$, p < 0,001	p < 0,001
after 12 months	0,97 ± 0,14***, p < 0,001	0,46 ± 0,09$^{***,\#\#}$, p < 0,001	p = 0,002

#, ##, ### – intergroup differences according to the Mann-Whitney test, respectively, at the level of perception p < 0.05, p < 0.01 and p < 0.001

,, *** – sensory values of indicators compared with the initial value before treatment at p < 0.05, p < 0.01 and p < 0.001, respectively (according to the Wilcoxon test)*

studied indices. Accordingly, in this category of persons, the decrease in the OHI-S index from the initial indicators occurred 3.3, 4.4, 1.8 times, for the PMA index 2.3, 4.5 times, for the SBI index 3.0, 2.6 times, for the GI index on average 2.1 times, for the PI index 2.5, 1.4 times, while its an increase was observed in a subgroup of individuals with clinically intact periodontal disease by the 6th month of dynamic follow-up and a decrease by 1.4 times by the year of follow-up (p < 0.001).

Thus, the revealed differences in the dynamics of the studied indices before and after the therapeutic and preventive measures compared with their baseline level by assessing intergroup differences allowed us to conclude that the clinical condition of periodontal tissues improved against the background of the influence of a diode laser and applications of adhesive plates based on biogel, which has a more significant advantage compared with the method of local treatment according to the clinical protocols of Dental Association of Russia, 2001.

Таблица 5

Changes in clinical parameters in patients of the control subgroup depending on the method of local treatment

Таблица 5. **Изменения клинических показателей у больных контрольной подгруппы в зависимости от метода местного лечения**

Index indicators	*III-control subgroup (n = 27) with a low titer of periodontopathogenic microflora and with local treatment according to the StAR protocol, 2001*	*IIIa- control subgroup (n = 8) with a high titer of periodontopathogenic microflora with the proposed complex of local treatment*	*Intergroup comparison*
Simplified index of oral Hygiene OHI-S (Green–Vermillion Index, 1964)			
before treatment	0,77 ± 0,15	1,57 ± 0,08$^{###}$	$p < 0,001$
after 2 weeks	0,39 ± 0,09, $p = 0,081$	0,10 ± 0,03$^{***,###}$, $p < 0,001$	$p < 0,001$
after 6 months	0,46 ± 0,11, $p = 0,111$	0,39 ± 0,07***, $p < 0,001$	$p = 0,149$
after 12 months	0,41 ± 0,13, $p = 0,098$	0,45 ± 0,08***, $p < 0,001$	$p = 0,718$
Papillary-marginal-alveolar index PMA (Parma S., 1960)			
before treatment	0	10,7 ± 2,51$^{###}$	$p < 0,001$
after 2 weeks	0	6,17 ± 0,06$^{***,###}$, $p < 0,001$	$p < 0,001$
after 6 months	0	7,42 ± 0,03$^{***,###}$, $p < 0,001$	$p < 0,001$
after 12 months	0	5,40 ± 0,04$^{***,###}$, $p < 0,001$	$p < 0,001$
Sulcus bleeding index (SBI) according to Mulleman and Son (1971) in the Cowell modification (1975)			
before treatment	0	0,65 ± 0,15$^{###}$	$p < 0,001$
after 2 weeks	0	0,45 ± 0,06$^{***,###}$, $p < 0,001$	$p < 0,001$
after 6 months	0	0	-
after 12 months	0	0,25 ± 0,15$^{***,###}$, $p < 0,001$	$p < 0,001$
Determination of the gingival index – GI (Loe, silness, 1963)			
before treatment	0	0,98 ± 0,04$^{###}$	$p < 0,001$
after 2 weeks	0	0	-
after 6 months	0	0	-
after 12 months	0	0	-
Periodontal index – (PI) according to Russel (WHO, 1956)			
before treatment	0	0,57 ± 0,08$^{###}$	$p < 0,001$
after 2 weeks	0	0	-
after 6 months	0,77 ± 0,06***, $p < 0,001$	0$^{***,###}$, $p < 0,001$	$p < 0,001$
after 12 months	0,57 ± 0,05***, $p < 0,001$	0$^{***,###}$, $p < 0,001$	$p < 0,001$

– intergroup deviations according to the Mann-Whitney test, respectively, at a perception level of p < 0.001
**** – the significance of various indicators compared with the initial value before treatment at p < 0.001 (according to the Wilcoxon test)*

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