

Article

Improvement of Pathogenetic Periodontal Treatment through Laser Combined with EHF Irradiation

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Abstract: Rationale. Verification of chronic generalized periodontitis is rated among the most promising areas of personalized therapy. Osteodestructive changes will inevitably lead to tooth loss. Correction of microcirculatory disturbances, which constitute one of the factors indicating the hemostasis of periodontal tissues, may help reduce the financial burden faced by the entire healthcare system when offering medical assistance to the respective category of patients.

Aim of study. This study was aimed at determining the role of combined laser and EHF irradiation in the pathogenetic therapy offered to cases of chronic generalized periodontitis.

Materials and methods. The whole set of periodontal treatment procedures offered to 40 patients was expanded with a combination of laser and EHF irradiation (MATRIX unit). As the study was carried out, clinical and laboratory values were recorded, as well as an assessment of the indicators for periodontal tissues was done, namely, measures were taken for the pocket depth; the contents of the pocket discharge was identified; the Muhlemann-Cowell index, the papillary-marginal-alveolar index (PMA), the plaque index (PI), and the oral hygiene index (OHI) were evaluated, along with the hemostasis system microcirculatory link studied – the platelet functional activity (adhesion and aggregation), in particular.

Results. The comprehensive treatment of periodontitis, which included combined laser and EHF irradiation, resulted in an improved clinical status: the depth of periodontal pockets revealed a decrease, whereas no suppuration was to be observed. The improvement in the periodontal tissues came along with positive dynamics of the following indices – the PMA index featured a statistically significant decrease; the PI values showed a change to a lesser extent compared to the PMA index, yet also within the statistically significant range; the oral hygiene improved, which manifested itself through an increase in the OHI values. Notable is that the difference in the index values taken prior to the comprehensive treatment and following it, was significant. This change in the indices is related closely to changes in the aggregation and adhesive capacity of platelets.

Conclusion. Given the above, the obtained data point at high efficiency of the combination of laser and EHF exposure introduced into the set of treatment measures offered for periodontal diseases. The clinical and laboratory data are important both as a theoretical expansion to the available knowledge and from the practical stance. Platelet functional activity indicators are important markers of inflammation issues affecting periodontium. The study outcomes allow viewing the combination of laser and EHF irradiation as an effective component of comprehensive treatment for the said pathology, as well as recommend it be introduced into the treatment plan.

Keywords: chronic generalized periodontitis, combined laser and EHF irradiation, disturbed microcirculation, index evaluation for periodontal tissue status.



1. Introduction

Diseases involving periodontium are one of the most complex pathologies faced by dentists, both in the Russian Federation and abroad, while ranking second in prevalence giving way to dental caries. As reported by the World Health Organization (WHO), 95% of the adult population and 80% of children globally, have been diagnosed with various clinical manifestations of inflammatory periodontal diseases (IPD) [1]. The overall medical and social role of IPD, taken as a special section within dentistry, is due to the following factors: high incidence; diverse etiology; tendency to progression; significant issues in arriving at stable remission; mild symptoms through the early stages; an increase in the number of young capable population featuring severe destructive and atrophic periodontal changes; possible loss of intact teeth; chronic infection foci arising due to the development of gingival and periodontal pockets, as well as their role in the occurrence of general somatic pathology [2-10]. The protective and compensatory periodontal mechanisms and the human body status as a whole is a factor that determines the prevalence and intensity degree of the inflammatory process [11-15].

Gingivitis and periodontitis account for the most common pathologies in the structure of periodontal diseases. The two health issues in question rely on inflammation, a typical pathological process based on changes occurring through the effects of periodontal pathogens [16-18].

The clinical picture of chronic generalized periodontitis in its early stages can be described by a low-manifest and latent course, which makes setting diagnosis in due time complicated and, respectively, leads to a later start of proper treatment and rehabilitation measures [19].

Microcirculation disorders associated with increased activity of the vascular-platelet hemostasis link play a key role in the IPD pathogenesis. Patients with chronic generalized periodontitis have disturbances involving both the aggregation-related function of platelets and their adhesive activity, whereas it is the severity of the disease course that is decisive for the degree of such disturbances [20-24]. One of the most significant effects wrought by helium-neon laser radiation is a positive impact it has on microcirculatory issues. There are results of numerous studies available, which confirm a significant decrease in blood viscosity and platelet aggregation activity. An important point about the hypo-coagulation effect of low-intensity laser radiation is the improvement in the kallikrein-kinin system values [25].

One of the mechanisms behind laser radiation effects is the generation of secondary weak radio emission belonging to the EHF band. A certain part of the biological effects of low-intensity laser radiation may be mediated by this endogenous EHF effect [25]. The advantage of such an impact implies high efficiency, non-invasiveness, none of any adverse responses and contraindications to use, low cost, and good compatibility with other methods [26].

Cells are known to produce electromagnetic vibrations of a very wide range through their life cycle. However, the predominantly narrow range of EHF waves is employed by cells to exchange information required to regulate intracellular functions and intercellular interaction [25,26]. An extra piece of proof to this idea is a response appearing on the side of both cells and the body as a whole, to low-intensity, informational influences [27].

Numerous studies have revealed that the best result when dealing with treating inflammatory periodontal diseases can be expected through combined treatment only, which includes etiological, pathogenetic and symptom-bound therapy [27]. Physiotherapeutic effects serve an extremely valuable component of combined treatment offered to cases of inflammatory periodontal diseases. Effective treatment of microcirculatory disorders determines largely the overall treatment in patients with inflammatory periodontal diseases and has a significant effect on the course of the diseases mentioned above [26]. Treating such disorders via non-medication methods, unlike pharmacotherapy, entails no side effects, and given their significant effectiveness, can be recommended as a component of comprehensive treatment for patients suffering from inflammatory periodontal diseases.

Aim of study

The study was aimed at identifying the role that combined laser and EHF irradiation have in the pathogenetic therapy of chronic generalized periodontitis.

2. Materials and Methods

The examination carried out within the study involved 40 patients with periodontitis, whose comprehensive treatment included the combined effects of laser and EHF irradiation (MATRIX device). Through the study, clinical and laboratory parameters were recorded, as well as an assessment carried out for the indicators showing the status of periodontal tissues: measures were taken for the pocket depth; the contents of the pocket discharge was identified; the Muhlemann-Cowell index, the papillary-marginal-alveolar index (PMA), the plaque index (PI), and the oral hygiene index (OHI) were evaluated, along with the hemostasis system microcirculatory link studied, namely, the platelet functional activity (adhesion and aggregation).



Platelet adhesion and aggregation were evaluated by the impedance method, the principle of which implies recording microcurrents flowing in a special electrode unit when it is immersed in a blood sample. During that, the change in the impedance (resistance) of the electrode system is measured. The impedance increase is in a direct proportion to the platelet mass deposited on the electrode unit. The impedance kinetics allows quantifying the kinetics of the aggregation process. The initial contact of the electrodes with the blood sample results in a platelet monolayer developing on them. Then, as agonists are added (ADP, collagen, arachidonic acid, ristocetin, etc.), there is a gradual aggregation of platelets on the electrodes happening, which leads to some typical changes in the electrical properties of the system.

This method also allows taking into account the leukocyte-platelet adhesion phenomenon observed in some patients' samples. The following parameters were used for quantifying aggregation: the degree of aggregation, which is estimated by the maximum aggregatogram amplitude, which corresponds to the maximum increase in the resistance at the electrode following the introduction of the inductor; the aggregation rate, which is estimated by the aggregatogram amplitude 1 minute following the aggregation start; the delay time – estimated by the time in seconds elapsed after the inductor addition and prior to the start of aggregation registration; the area under the aggregation curve – the product of the amplitude and the rate of its development.

The obtained data statistical processing was performed using the EXCEL and STATISTICA 6.0 software package, with the average value and the average error determined based on the Student and Mann-Whitney reliability criteria.

3. Results

An objective examination of the patients with generalized periodontitis undergoing treatment showed a significant decrease or complete disappearance of inflammation affecting the free and attached gums. Respectively, the depth of periodontal pockets featured a decrease (from 5.28±0.17 mm to 4.04± 0.24 mm), whereas their suppuration was no longer to be observed. Apart from the clinical improvement, there was also positive dynamics registered in the indices. The papillary-marginal-alveolar index demonstrated a statistically significant decrease, if compared to the values obtained prior to the treatment (mild chronic generalized periodontitis cases – by 82.76±3.62%; patients with moderate degree – by 81.1±3.29%; severe cases – by 75.35±2.98%) (Table).

Table 1. Changes in the indices due to the effect of laser and EHF irradiation treatment in patients with periodontitis

Index Group		Oral hygiene index, points	Papillary-marginal-alveolar index, %	Periodontal index, points	
		Control (n = 20)		1.03(0.9;1.2)	3.21 (1.1;5.3)
Chronic generalized periodontitis	Mild course (n=20)	Prior to treatment	2.12 (1.8;2.2) Z1=3.71; p1=0.000205	47.75 (40.1;52.4) Z1=5.17; p1=0.000001	3.47 (2.9;4.1) Z1=4.67; p1=0.000003
		Following treatment	1.17 (0.9;1.4) Z1=1.47; p1=0.140895; Z2=3.92; p2=0.000089	8.23 (4.9;12.6) Z1=2.51; p1=0.012093 Z2=4.67; p2=0.000003	1.74 (1.2;3.5) Z1=2.74; p1=0.006190; Z2=2.05; p2=0.040057
	Moderate course (n=20)	Prior to treatment	2.24(2.1;2.4) Z1=4.33; p1=0.000015	65.6 (51.6;76.8) Z1=5.32; p1=0.000001	4.25 (3.9;4.8) Z1=5.07; p1=0.000001
		Following treatment	1.34 (1.2;1.6) Z1=2.43; p1=0.015247; Z2=3.11; p2=0.001866;	12.41 (5.6;17.1) Z1=3.11; p1=0.001866; Z2=5.18; p2=0.000001	2.25 (1.8;2.6) Z1=2.74; p1=0.006190; Z2=4.00; p2=0.000063



	Severe course (n = 20)	Prior to treatment	2.62 (2.5;2.9) Z1=4.29; p1=0.000018	84.4 (78.2;87.3) Z1=6.87; p1=0.000001	6.37 (5.9;7.1) Z1=5.87; p1=0.000001
		Following treatment	1.62(1.5; 1.8) Z1=2.63; p1=0.008443; Z2=3.82; p2=0.000136;	20.8 (17.6;24.2) Z1=4.58; p1=0.000005; Z2=6.68; p2=0.000001	4.13 (3.8;4.5) Z1=3.11; p1=0.001866; Z2=4.58; p2=0.000005

Note: each case demonstrates the average value, the lower and the upper quartiles (25%;75%); Z1, p1 – compared with the control group; Z2, p2 – compared with the group of patients prior to treatment.

The periodontal index showed a smaller change (in patients with mild chronic generalized periodontitis – by 49.85±2.08%; in cases of moderate degree – by 47.0±2.31%, whereas patients with severe course featured a decrease of 35.16±1.88%), which, however, fell within the statistically significant range (p<0.05). This can be accounted for by the treatment eliminates inflammatory phenomena in periodontal tissues only, yet do not eliminate the periodontal pocket. Along with inflammation subsiding, there was an improvement noted in the hygiene status of the oral cavity, which expressed itself through positive dynamics in the oral hygiene index values (Table). A comparison of the indices before and after the treatment made it obvious that the best clinical results were to be observed after treatment with the MATRIX unit, the difference in the indices being significant (p<0.05).

The changes in the indices correlate closely with changes in platelet aggregating and adhesive capacity [26]. The identified correlations of clinical and laboratory data are of importance both in view of theoretical understanding and of practical application. From the theoretical stance, the data explain the mechanism behind pathogenetic changes in periodontal tissues in case of inflammatory diseases. As far as practical use is concerned, platelet functional activity indicators constitute important differential and diagnostic criteria for evaluating inflammatory periodontal diseases [27].

4. Discussion

Comprehensive treatment employing combined laser and EHF irradiation results in a significantly improved clinical course of inflammatory periodontal diseases. This is to be seen from a statistically reliable improvement in the oral hygiene index, the papillary-marginal-alveolar index, as well as the periodontal index. Combined laser and EHF irradiation with a MATRIX device allows putting to a quick stop inflammation in periodontal tissues and prepare patients for the surgical stage of treatment, also preventing complications [28].

The above means that the obtained data serve proof to a high efficiency of combined laser and EHF exposure if used as a pathogenetic therapy aimed at improving the hemostasis system microcirculatory link.

5. Conclusion

When dealing with patients suffering from chronic generalized periodontitis, there is a need to study the aggregation and adhesive activity of platelets, which is to be done through laser aggregatometry.

Combined laser and EHF exposure has a significantly positive effect on the status of the hemostasis system microcirculatory link in patients with chronic generalized periodontitis. The most pronounced effect can be observed in mild and moderate cases.

The high efficiency obtained through combining the effects of laser and EHF irradiation when treating microcirculation disorders is due to an increase in the adhesive and aggregating capacity of platelets, and this allows proposing the said method to be used as part of the comprehensive treatment administered to patients suffering from the respective pathology.

Application of artificial intelligence:

The article is written without the use of artificial intelligence technologies.

Conflicts of Interest: The authors declare no conflict of interest.



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