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Original article

Predicting the course of localized periodontitis of traumatic etiology after complex treatment

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Abstract: Due to the noteworthy prevalence of inflammatory periodontal diseases among the population, especially in older age groups, the problem of providing timely and quality care to prevent severe complications leading to tooth loss becomes urgent. Conventional approaches to treatment are not always successful and do not necessarily provide a lasting effect. Therefore, predicting the outcome of the disease is a critical task.

Material and Methods — We performed examination of 169 individuals and treatment of 126 patients aged 45-75 years with mild to moderate localized periodontitis of traumatic etiology (LPT) were performed. We employed clinical, radiological, and functional methods of examining periodontal condition, and investigated laboratory blood parameters (complete blood count, C-reactive protein). To assess the body's adaptive resources, the entropy of the leukocyte blood count was calculated, and risk factors for the occurrence of LPT were assessed. Predicting the course of LPT based on changes in clinical and radiological indicators was accomplished by assessing treatment outcomes and calculating a prognostic score.

Results — Patients exhibited a noteworthy prevalence of somatic pathology, with cardiovascular diseases (RR=2.32), anemia (RR=2.26), and gastrointestinal tract disorders (RR=1.88) emerging as predominant conditions ($p<0.001$). The duration of the disease exceeding three years was associated with a 2.06-fold increase in the risk of developing moderate-grade LPT ($p=0.017$). With a concentration of C-reactive protein in the range of 3-10 mg/L, the risk of developing moderate-grade LPT increased 1.74-fold (RR=1.74; $p=0.0022$). The intense type of adaptive reaction of the body was detected in 30.4% and 50.7% of cases with mild and moderate grades of LPT, respectively, increasing the risk of a more severe grade by 1.8 times ($p=0.0026$). Pronounced local changes in the bone tissue of the alveolar process were observed 1.6-2 times more often in cases of moderate periodontitis vs. mild LPT ($p=0.0035$). Microcirculation in the inflammation zone decreased by 32% and 50.1% with mild and moderate grade of the disease, respectively ($p<0.001$). Splinting of teeth in the area of the pathological focus during treatment led to improved clinical indicators vs. the control group ($p=0.012$).

Conclusion — Based on the study results, the prognosis for the course of LPT was most significantly influenced by the following factors: the concentration of C-reactive protein, the grade of LPT, the entropy of the leukocyte blood count, changes in the alveolar bone of the jaw, the duration of the disease, the history of previous periodontal treatment, and tooth splinting. Calculation of a prognostic score for the treatment outcome of LPT allows to qualitatively assess the clinical situation and identify a group at risk of an adverse treatment outcome.

Keywords: grades of periodontitis, predicting the course of localized periodontitis.

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Introduction

The prevalence of inflammatory periodontal tissue diseases shows no declining trend, thereby affecting up to 90% of the global population [1]. Periodontitis accounts for 20 to 50% of cases, with a severe grade of the disease developing in 9.1 to 15% of the population irrespective of the ethnic group [2, 3]. The disease is most frequently diagnosed among individuals aged 40 years and above [4, 5]. Common complications of the disease include tooth mobility and loss, the emergence of odontogenic infectious foci, and sensitization of the body [6, 7].

To assess the severity of periodontitis, it is necessary to study the clinical characteristics of the dental organs. Measurement of clinical attachment loss (CAL) and periodontal pocket probing depth (PD) as well as sulcus bleeding index (SBI) are important diagnostic criteria [8].

Efforts to evaluate the disease prognosis have been underway for a long time. Many commonly accepted prognostic factors have been proven ineffective in predicting tooth loss. At the same time, the effect of clinical parameters on the initial prognosis for tooth preservation is only partial, as some parameters require more detailed study and evaluation [9, 10, 11].

Table 1. Gender and age structure of patients with LPT of mild and moderate grade

Age groups (y/o)	*Grade*								*Total (n=169)*		
	Mild (n=102)				Moderate (n=67)						
	Count	%	95% CI	%	Count	%	95% CI	%	Count	%	95% CI
45-60	81	79.4	70.6-86.1	15.7 M	45	67.2	55.3-77.2	7.5 M	126	74.6	67.5-80.5
61-75	21	20.6	13.9-29.4	84.3 F	22	32.8	22.8-44.7	92.5 F	43	25.4	19.5-32.5
	χ^2=3.20; p=0.074								-		

LPT, localized periodontitis of traumatic etiology; CI, confidence interval.

Table 2. Distribution of LPT patients in clinical groups by grade (N)

Group	*Severity of LPT*				*Total*	
	Mild		Moderate			
	Count	%	Count	%	Count	%
Main	43	62.3	26	37.7	69	100.0
Comparison	37	64.9	20	35.1	57	100.0
Total	80	63.5	46	36.5	126	100.0

LPT, localized periodontitis of traumatic etiology.

Predicting the disease involves establishing the relationship between each significant clinical factor and the likelihood of disease development or progression [9, 10]. The course of inflammatory periodontal diseases is affected by individual genetic predisposition of a patient including the polymorphism of cytokine genes, such as interleukin-1 (α, β), interleukin-6, interleukin-8, and interleukin-10 [8, 12]. The course of inflammatory periodontal diseases can be also influenced by a combination of general factors, such as smoking and somatic diseases, as well as local factors (e.g., presence of specific periodontal pathogens, viruses, and flawed individual and professional oral hygiene. This combination may result in a refractory response to periodontal treatment [13, 14]. The initial prognosis and location of the tooth (molars, upper jaw teeth), along with the patient age, are associated with the probability of tooth loss during maintenance treatment [15].

In case of periodontal tissue diseases, the adaptive capabilities of resistance to functional occlusal loads are reduced [16]. The prognosis for the safety of teeth with damage to periodontal tissues, combined into a single structure, is significantly increased by reducing occlusal trauma and tooth mobility [17].

Psychoemotional stress and the absence or low compliance of patients can contribute to the destruction of periodontal tissue in individuals susceptible to inflammatory periodontal diseases, especially in the presence of periodontal pathogens [15].

The type of tooth, the number of affected surfaces and the degree of tooth mobility are risk factors for successful conservative treatment of periodontitis [16]. Predicting the outcome of the disease in multirooted teeth is much more difficult than in single-rooted teeth [11, 18].

Therefore, the development of a prognostic system is an urgent task aimed at improving the quality of treatment of localized processes in periodontal tissues.

The *goal of our study* was to predict the long-term outcomes of complex treatment of localized periodontitis of traumatic etiology.

Material and Methods

We conducted a survey of 169 participants and performed complex treatment of 126 patients aged 45 to 75 years (18 male and 108 female). Study participants had a confirmed diagnosis of localized periodontitis of traumatic etiology (LPT).

Taking into account the grade of LPT, participants were categorized into two groups: those with mild manifestations (PD up to 4 mm) and those with moderate LPT (PD from 4 to 6 mm). Patients with a severe grade of LPT were not included in our study due to their complicated anamneses.

Both groups were homogeneous in terms of the gender/age structure and concomitant diseases in their compensated stages (*Table 1*).

Exclusion criteria from the study were as follows: clinical situations with low-attached soft tissue formations (webs, frenula), dystopia of individual teeth, malocclusion, and patient refusal to participate in the study.

At the diagnostic stage of treatment, patients filled out a questionnaire to determine the presence and nature of comorbid pathology, the duration of LPT, as well as information about previous treatment of periodontal tissues or its absence.

Instrumental research methods included laser Doppler flowmetry of periodontal tissues using a laser capillary blood flow analyzer LAKK-01 (LAZMA Scientific Production Enterprise, Russia) before treatment and at different stages of treatment, radiography by dental tomograph Orthophos SL 3D, Sirona Dental Systems, Germany), as well as laboratory diagnostics (complete blood count) to calculate leukocyte blood count entropy (LBCE) [19] in order to assess the adaptive capabilities of the body. LBCE values of 56–67%, 68–75% and over 75% were considered normal adaptation, stress reaction and insufficient adaptation, respectively. LBCE was calculated as the ratio of the actual load of the blood leukocyte system (H) to its maximum capacity (H_{max}). The level of C-reactive protein was also determined.

Complex treatment included professional oral hygiene, as well as conservative or (in case of moderate LPT grade) surgical interventions for the treatment of periodontal tissue.

Taking into account the treatment algorithm, patients with LPT were divided between two groups: main and control, consisting of 126 individuals (*Table 2*). The proportion of patients with mild LPT in the main group was 62.3% (43 patients) vs. 64.9% (37 patients) in the comparison group. The proportion of patients with moderate LPT in the main group was 37.7% (n=26) versus 35.1% (n=20) in the comparison group.

As part of complex treatment, tooth splinting was used as one of the treatment measures in the main group. The comparison group included patients who did not undergo splinting.

Treatment of patients was carried out in accordance with clinical recommendations for the diagnosis of periodontitis, approved by the Decision of the Council of the Russian Dental Association of April 23, 2013, with later amendments based on Decision No. 15 of September 30, 2014 (Good Clinical Practice) and the Declaration of Helsinki principles [20].

Table 3. Frequency of detection of concomitant pathology and relative risk of disease development in patients with LPT of varying grade (per 100 patients)

Somatic pathology	*LPT grade, %*		*RR and 95% CI*	*p*
	Mild	Moderate		
Anemia	23.5	56.7	2.26 [1.56-3.27]	<0.001
Allergies	41.2	55.2	1.41 [0.97-2.04]	0.075
Respiratory diseases	22.5	41.8	1.66 [1.16-2.75]	<0.001
Diseases of the genitourinary system	34.3	53.7	1.61 [1.11-2.32]	0.013
Diabetes mellitus (type 2)	10.8	20.9	1.52 [1.04-2.29]	0.044
CAD	35.3	68.7	2.32 [1.53-3.53]	<0.001
Patients with gastroenterological issues	50.0	73.1	1.88 [1.20-2.93]	<0.01
Gastrointestinal diseases	7.8	17.9	1.52 [1.04-2.29]	0.044

LPT, localized periodontitis of traumatic etiology; RR, relative risk; CI, confidence interval; CAD, coronary artery disease.

Table 4. Distribution of patients with LPT of varying grade by duration of the disease

Duration of the disease (years)	*Grade*						p	*RR*	*95% CI*	*p*
	Mild (n=02)			Moderate (n=67)						
	Count	%	95% CI	Count	%	95% CI				
Under 3 years	39	38.2	29.0-47.9	12	17.9	9.6-28.1	0.0049	Reference category		
From 3 to 5 years	31	30.4	21.8-39.7	25	37.3	26.0-49.4	0.35	1.90	1.07-3.37	0.029
5 or more years	32	31.4	22.7-40.8	30	44.8	32.9-56.9	0.077	2.06	1.18-3.59	0.011
			χ^2=8.10; p=0.017				-	-	-	-

LPT, localized periodontitis of traumatic etiology; RR, relative risk; CI, confidence interval.

Table 5. C-reactive protein in blood serum of the patients with LPT of varying grade

CRP level	*Mild severity*			*Moderate severity*			*RR and 95% CI*
	Count	%	95% CI	Count	%	95% CI	
Up to 3 mg/L	86	84.3	76.0-90.1	44	65.7	53.7-75.9	1.74 [1.22-2.49];
3-10 mg/L	16	15.7	9.9-24.0	23	34.3	24.1-46.3	p=0.0022
Total	102	100.0	-	67	100.0	-	-
	χ^2=7.92; p=0.0049						-

LPT, localized periodontitis of traumatic etiology; RR, relative risk; CI, confidence interval; CRP, C-reactive protein.

The clinical study protocol was approved by the Ethics Committee of the North-Western State Medical University named after I.I. Mechnikov. All study participants signed informed written consent before the start of the study.

At the end of the study, the obtained data were processed using the STATISTICA 10.0 software (StatSoft, USA, license No. BXXR310F964808FA-V). Depending on the type of studied indicators and the nature of their distribution, parametric tests (Student's t-test for independent groups) and nonparametric tests (chi-squared test, Fisher's exact test) were employed in comparative analyses. Quantitative indicators were presented as M ± σ, while qualitative indicators were presented as a frequency distribution with a 95% confidence interval (CI).

Relative risk (RR) of an adverse treatment outcome was calculated based on the presence or absence of predisposing factors influencing the course of LPT. ROC analysis was carried out by constructing an ROC curve that determined the relationship between true positive and false negative treatment outcomes. To rank the indicators that influence the outcome of LPT treatment, an algorithm was used to construct classification trees (where the model variable was the outcome of treatment after 1 year: favorable or adverse). A prognostic scale was constructed that allowed dividing LPT patients into two groups based on their long-term treatment outcomes (1 year after completion of treatment). When testing statistical hypotheses, p=0.05 was set as the critical level of significance.

Results

The effect of somatic pathology

Survey of patients revealed a significant level of somatic diseases. A mild grade of LPT was observed in patients with gastrointestinal diseases and allergies (50% of cases), diseases of the circulatory system (35.3%), genitourinary system (34.3%), anemia (23.5%), diseases of the respiratory system (22.5%), as well as type 2 diabetes mellitus (10.8%). In LPT of moderate grade, a higher percentage of somatic diseases was noted vs. the group with mild LPT grade: gastrointestinal disorders (73.1%), diseases of the circulatory system (68.6%), anemia (56.7%), allergies (55.2%), diseases of the genitourinary system (53.7%), diseases of the respiratory system (41.8%), type 2 diabetes mellitus (20.9%) (*Table 3*).

The effect of the disease duration

A correlation has been established between the duration and severity of the disease, which was largely due to statistically significant differences in the severity of the disease when it lasted less than three years (*Table 4*).

According to *Table 4*, the proportion of patients with a disease duration of less than three years and mild grade was 38.2% vs. half as much with moderate grade (17.7%, p=0.0049). Patients with a disease duration of five years or more predominated in those with moderate LPT; in patients with such duration of LPT, the risk of developing its more severe grade increased by 2.06 times vs. the patients with a disease duration of less than three years.

The effect of the body's adaptive response to a course of LPT

A significant correlation was identified between the concentration of C-reactive protein in blood serum and the grade of LPT (χ^2=7.92; p=0.0049). E.g., at the concentration of this indicator within preclinical range (3-10 mg/L), the risk of developing LPT of moderate grade was 1.74 times higher vs. concentrations below 3 mg/L (RR=1.74 [1.22-2.49]; p=0.0022) (*Table 5*).

Table 6. Distribution of LBCE values in patients with LPT on the diagnostic matrix of body adaptation levels, %

LBCE level	*Mild grade*			*Moderate grade*			*p*	*RR and 95% CI*
	Count	%	95% CI	Count	%	95% CI		
Norm (from 56 to 67%)	71	69.6	60.1-77.7	29	43.3	32.1-55.2	<0.001	Reference level
Stress reaction (from 67% to 75%)	31	30.4	22.3-39.9	34	50.7	39.1-62.3	0.0078	1.80 [1.23-2.65]; p=0.0026
Insufficient adaptation (over 75%)	0	0	0.0-3.6	4	6.0	2.3-14.4	0.023*	3.45 [2.54-4.69]; p<0.001
Total	102	100.0	-	67	100.0	-	-	-
			χ^2 = 15.18; p <0.001					

LPT, localized periodontitis of traumatic etiology; LBCE, leucocyte blood count entropy; RR, relative risk; CI, confidence interval. * significance of the Fisher's exact test; in other cases, significance of the χ^2 test.

Table 7. Radiological changes in LPT of varying grade

Nature of the change	*Mild grade (N=102)*			*Moderate grade (N=67)*			*p*
	Count	%	95% CI	Count	%	95% CI	
Bone resorption up to ⅓ of the tooth root length	23	22.5	15.5-31.6	30	45.6	33.5-56.6	0.023
Bone resorption up to ⅓ of the tooth root length	0	0.0	0.0-3.6	16	24.5	15.3-35.3	<0.001
Osteoporosis of the interalveolar septum	64	62.7	53.1-71.5	56	83.6	72.9-90.6	0.0035
The contours of the interdental septum apex are fuzzy, uneven with notches.	56	54.9	45.2-64.2	57	85.1	74.7-91.7	<0.001

LPT, localized periodontitis of traumatic etiology; CI, confidence interval.

Table 8. Indicators of microcirculation in periodontal tissues in patients with LPT of varying grade, M±σ

PFU index	*Grade*					
	Mild (N=102)			Moderate (N=67)		
	Pathology zone	T-zone	p	Pathology zone	T-zone	p
MI	10.40±2.01	15.28±1.16	<0.001	7.01±0.97	13.98±0.83	<0.001

PFU, perfusion units; MI, microcirculation index; T-zone, test zone.

The study analyzed the levels of adaptation in various clinical groups of patients with LPT diagnosed based on LBCE ranges.

Analysis of the distribution of LBCE values showed that LBCE values within the normal range in patients with mild LPT were recorded in 69.6% of cases vs. 43.3% in patients with moderate LPT (*Table 6*).

Stress reaction was detected in 30.4% of patients with mild LPT grade vs. 50.7% of patients with moderate LPT. The state of insufficient adaptation was detected only in patients with moderate severity of LPT (6%).

Changes in the bone structures of the alveolar process of the jaws in LPT

An X-ray examination at the diagnostic stage revealed localized changes in the bone tissue of the alveolar process of the jaws.

With a mild grade of LPT and PD up to 4 mm, the initial degree of destruction of the cortical plates of the apices of the interdental septa (up to ⅓ of the length of the tooth root) was observed in 22.5% of cases. On the contrary, the proportion of patients with moderate grade who had resorption up to ⅓ of the tooth root length was statistically significantly higher, amounting to twice as much (p=0.023) (*Table 7*).

In 24.5% of patients with moderate LPT, the interalveolar processes were destroyed at ½ height relative to the root length, with a significance level of p<0.001. This destruction was especially pronounced in the proximal region, where the overhanging edges of fillings or the edges of crowns were located deep under the gum, thereby invading the biological width zone. The deepest foci of destruction were detected in these areas.

With mild grade of LPT, the development of areas of osteoporosis in the interdental septa was observed in 52.4% of cases. Destructive foci were detected in the lamina compacta, indicating localized points of damage. The percentage of patients with osteoporotic changes in the area of the interdental septum was significantly higher (1.6-fold) in moderate LPT vs. mild grade (p=0.0035) (*Table 7*).

In the group with mild LPT, loss of clarity and uneven contours were observed at the apices of the interalveolar septa with less contrast vs. healthy areas in 54.9% of cases. The proportion of patients with LPT of moderate grade and the presence of this radiological symptom was statistically significantly higher (1.5-fold, p<0.001) (*Table 7*).

Changes in microcirculation in periodontal tissues vs. LPT grade

To examine the impact of varying LPT grade on blood circulation in periodontal tissues, our assessment focused on local microcirculation in the marginal gum within the area of the pathological process at the diagnostic stage of the study (*Table 8*).

As shown in *Table 8*, the count of functioning capillaries (microcirculation index) in individuals with LPT of mild grade within the area of the pathological focus decreased by 32%, while in those with moderate grade, it dropped by 50.1% vs. the control area (p<0.001).

Effect of dental splinting on the effectiveness of treatment

Tooth splinting with both temporary and permanent structures in the main group of patients has led to clinical results of improved quality in periodontal tissues. This was manifested in lower CAL (p=0.012), decreased PD (p=0.019) and a lower local papillary alveolar marginal index (p=0.01). It should be noted that a decrease in the SBI (p=0.28) and the oral hygiene index (OHI) (p=0.13) after treatment was noted in both groups, regardless of the treatment method. A faster restoration of microcirculation in the pathological zone occurred in the main group with a normal adaptive reaction of the body (p=0.0069); however, after one year, microcirculation index values were similar. In case of stress reaction, blood flow indicators in both groups were restored three times slower (p=0.011). It is also important to note that after a year, 13.3% of patients in the group without splints did not achieve the values characteristic of the control zones (p=0.031).

Table 9. Indicators for calculating the prognostic scale

Prognostic indicator	*Degree of expression*	*Score in points (A_i)*	*Weight factor (K_i)*	*Prognostic score (PS)*
LBCE	insufficient adaptation stress reaction normal adaptation	1 2 3	1.0	$A_1 \times K_1$
CRP, mg/L	over 3 mg/L up to 3 mg/L	1 3	0.96	$A_2 \times K_2$
Grade of LPT	moderate mild	1 3	0.81	$A_3 \times K_3$
MI, PFU	up to 7 from 7 to 9 9 or more	1 2 3	0.8	$A_4 \times K_4$
Treatment method	no splinting with splinting	1 3	0.79	$A_5 \times K_5$
Bone resorption, fraction	up to 1/2 up to 1/3 none	1 2 3	0.78	$A_6 \times K_6$
Osteoporosis	yes none	1 3	0.69	$A_7 \times K_7$
Fuzzy contours of the interdental septum apex, uneven with notches	yes none	1 3	0.63	$A_8 \times K_8$
Duration of the disease (years)	5 years and more from 3 to 5 years under 3 years	1 2 3	0.51	$A_9 \times K_9$
Range of variation of the prognostic score: PS_{min}=6.97; PS_{max}=20.91				$\Sigma(A_i \times K_i)$

LBCE, leucocyte blood count entropy; CRP, C-reactive protein; LPT, localized periodontitis of traumatic etiology; PFU, perfusion units; MI, microcirculation index.

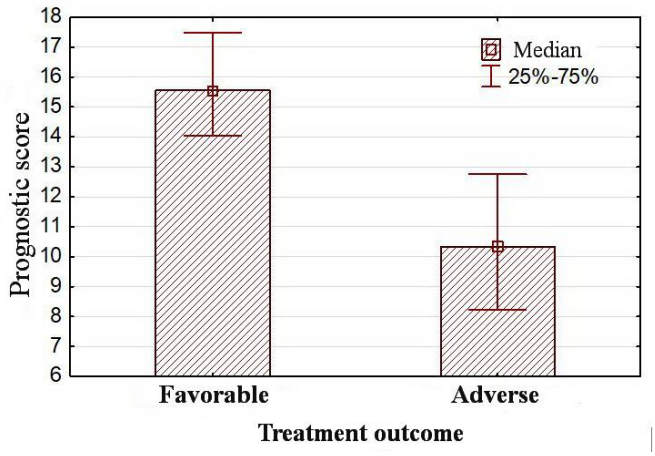

Figure 1. Prognostic score in groups of patients with LPT with different treatment outcomes.

Algorithm for predicting the course of LPT via assessment of predisposing factors

In patients with LPT, the outcome of complex treatment (favorable/adverse) was assessed by the dynamics of clinical and radiological (reduced PD, smaller CAL, absence of inflammatory resorption of the alveolar process), as well as functional indicators (no significant differences in microcirculation in the area of the pathological focus and the T-zone after complex treatment) for 12 months after treatment.

To rank indicators characterizing the clinical and anamnestic status of patients before treatment, we used the decision tree algorithm for the results of instrumental and functional methods, along with applied therapeutic and preventive dental measures, based on their impact on the course of the disease in the long term. The dichotomous variable, *'treatment outcome'* (after a year), with two gradations (favorable/adverse) acted as a simulation model variable.

Using the full univariate branch iteration method allowed ranking all predictor variables based on the calculated rank scaled on a 100-point scale. The highest values exceeding 50 points corresponded to nine indicators.

The highest rank of effect on the treatment outcome was detected in indicators that determine the functional capabilities of the body (LBCE) and the level of C-reactive protein as a marker of chronic inflammation with a score from 100 to 96 points. The severity grade of the disease, the level of microcirculatory support of periodontal tissues, the use of splinting elements in the complex treatment of LPT, and the severity of inflammatory resorption of the alveolar process of the jaw had a rating of 81 to 78 points. Radiological indicators (osteoporosis and fuzzy contour of the apices of the interdental septa) received lower ranking values (69 and 63 points), as well as the duration of the disease (51 points). The lowest ranked indicators with a score of 50 points or less were not included in the prognosis of treatment outcomes. These indicators were used to construct a prognostic scale for long-term results of LPT treatment (*Table 9*).

Each prognostic indicator, depending on the severity grade, was assigned a score (A_i=1÷3 points). The weighting coefficient (K_i) corresponded to the rank of each indicator in relative units. The product of A_i and K_i determined the contribution of each indicator to the overall prognostic score (PS). Expression for its calculation is as follows:

$$PS = \sum_{i=1}^{9} A_i \times K_i \quad (1)$$

Depending on the treatment outcome (favorable or adverse) in patients with LPT, the values of PS calculated using formula (1) were significantly different ($p<0.001$) (*Figure 1*).

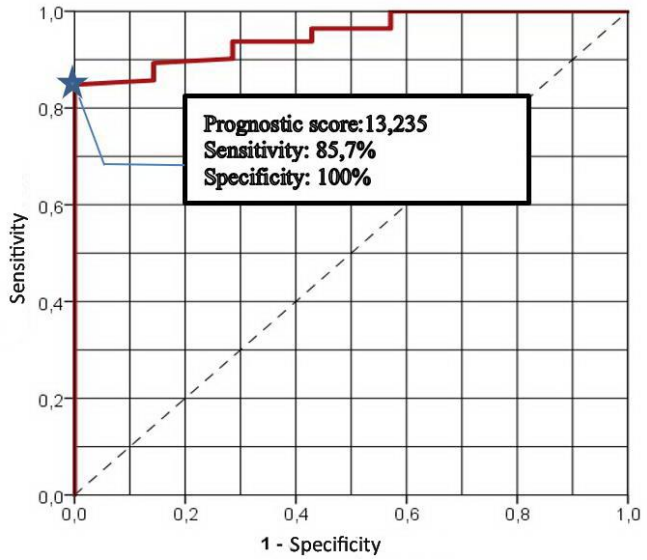

Figure 2. ROC curve of the Prognostic score indicator.

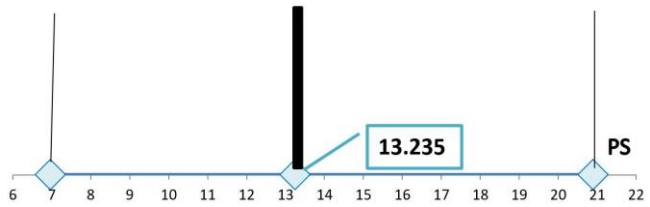

Figure 3. Prognostic scale of long-term LPT treatment outcomes.

PS, prognostic score.

During the ROC analysis, the threshold value of the prognostic scale was calculated, dividing it into two areas corresponding to different treatment outcomes. This method is based on the construction and analysis of a receiver operating characteristic (ROC) curve. This curve is a visual representation of the relationship between true positives and false positives (sensitivity and value 1 minus specificity) of a diagnostic method. Analysis of ROC curve of the PS indicator (*Figure 2*) showed that when choosing the value of PS=13.235 points as the threshold value, a sensitivity of 85.7% and a specificity of 100% are achieved.

Thus, according to the results of the ROC analysis, a threshold of 13.235 points separated LPT patients with an adverse outcome (PS<13.235) from LPT patients with a favorable outcome (PS≥13.235). The obtained data made it possible to develop a prognostic scale for long-term treatment outcomes (*Figure 3*).

A comparison of the observed and predicted treatment outcomes using the proposed prognostic scale revealed the high accuracy of the constructed decision rule: 108 out of 126 patients were classified correctly, i.e., the accuracy of the method was 85.7%, while the accuracy of predicting the adverse outcome was the highest possible (100%).

To predict long-term outcomes of treatment in patients with mild and moderate LPT using the proposed prognostic scale, it is necessary to enter a score of the patient's indicators before treatment (including the anticipated treatment method) and the corresponding weight coefficient values presented in *Table 6* into expression (1). If the PS calculated for a particular patient is at least 13.235 points, then the most likely treatment outcome will be favorable, otherwise it will be adverse.

Predicting an adverse outcome of treatment for a patient with LPT allows identifying optimal approaches to control the inflammatory process in periodontal tissues at the diagnostic stage of treatment.

Discussion

Somatic pathology in the body activated pathological processes in periodontal tissues in 85% of cases [21]. The connection between inflammatory diseases of periodontal tissues and noncommunicable diseases of the body has been proven and is characterized by an increase in biomarkers in the blood and gingival fluid [22].

A combined assessment of the patient's general somatic and dental status, especially the local segment of the dentition at the site of the inflammatory focus, as well as an additional study of the microcirculation of periodontal tissues in combination with an analysis of the adaptive capabilities of the body based on laboratory data (C-reactive protein level and calculation of LBCE), helped us identify common risk factors with different characteristics [23]. The combination of several non-individually important characteristics can lead to a significant change in treatment outcome.

A preclinical increase in the concentration of C-reactive protein in the blood serum aggravates the course of LPT. Measuring the concentration of C-reactive protein makes it possible to determine and monitor the course of the chronic inflammatory process in periodontal tissues.

Conservative treatment of periodontal diseases has a short-term effect due to limited therapeutic options and inadequate assessment of the degree of mineralization of the jaw bones [24, 25].

The choice of adequate treatment tactics for LPT in patients with a high risk of disease progression is an effective measure through the use of an integrated approach to the treatment of LPT, taking into account the adaptive capabilities of the body. This reduces the duration of treatment and the number of adverse outcomes.

The proposed methodological approach uses a prognostic scale constructed by considering the severity grade and ranked significance of nine indicators in patients with LPT, which makes it possible to classify each patient with LPT into one of two prognostic groups based on treatment results (favorable or adverse). Based on a comprehensive assessment of general somatic and dental status, it was possible to identify a high-risk group for predicting an adverse outcome of LPT treatment. A patent for the invention was received for this method of disease prediction (#2745698 MPK A61 C 7/00; A 61 C 7/002).

Conclusion

The use of a prognostic scale for long-term treatment outcomes of localized periodontitis of traumatic etiology allows qualitatively assessing any clinical situation and identifying a group at risk of an adverse treatment outcome. This makes it possible to determine the optimal management tactics for a patient with LPT at the diagnostic stage of treatment, which, in turn, allows reducing the duration of treatment and the number of adverse outcomes of LPT treatment.

Limitations

To optimize the treatment of LPT, we only considered treatment methods that were approved by the Resolution of the Russian Dental Association and corresponded to the clinical treatment protocol for the diagnosis of periodontitis [20]. When selecting methods for diagnosing LPT and monitoring treatment outcomes, economically feasible approaches to clinical, instrumental, and laboratory examinations were employed. The improvement of investigated methods for treating LPT was carried out solely through solutions available within the territory of the Russian Federation.

Conflict of interest

The authors declared no conflicts of interest. The study was carried out within the priority area of research in Department of General Dentistry of Northwestern State Medical University and Department of Dentistry, School of Dentistry and Medical Technology, St Petersburg University.

Ethical approval

The clinical study protocol was approved by the Ethics Committee of the North-Western State Medical University named after I.I. Mechnikov. All study participants signed informed written consent before the start of the study.

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